ECOLOGICAL SURVEY OF THE PROPOSED BIG PINE MOUNTAIN RESEARCH NATURAL AREA LOS PADRES NATIONAL FOREST, SANTA BARBARA COUNTY, CALIFORNIA

TODD KEELER-WOLF
FEBRUARY 1991
(PURCHASE ORDER # 40-9AD6-9-0407)

INTRODUCTION 1
Access 1
PRINCIPAL DISTINGUISHING FEATURES 2
JUSTIFICATION FOR ESTABLISHMENT 4
Mixed Coniferous Forest 4
California Condor 5
Rare Plants 6
Animal of Special Concern 7
Biogeographic Significance 7
Large Predator and Pristine Environment 9
Riparian Habitat 9
Vegetation Diversity 10
History of Scientific Research 11
PHYSICAL AND CLIMATIC CONDITIONS 11
VEGETATION AND FLORA 13
Vegetation Types 13
Sierran Mixed Coniferous Forest 13
Northern Mixed Chaparral 22
Canyon Live Oak Forest 23
Coulter Pine Forest 23
Bigcone Douglas-fir/Canyon Live Oak Forest 25
Montane Chaparral 26
Rock Outcrop 28
Jeffrey Pine Forest 28
Montane Riparian Forest 31
Shale Barrens 33
Valley and Foothill Grassland 34
FAUNA 35
GEOLOGY 37
SOILS 37
AQUATIC VALUES 38
CULTURAL VALUES 38
IMPACTS AND POSSIBLE CONFLICTS 39
MANAGEMENT CONCERNS 40

BOUNDARY CHANGES 40
RECOMMENDATIONS 41
LITERATURE CITED 41
APPENDICES 41
Vascular Plant List 43
Vertebrate List 52
PHOTOGRAPHS AND MAPS 57

INTRODUCTION

The Big Pine Mountain candidate Research Natural Area (RNA) is on the Santa Lucia Ranger District, Los Padres National Forest, in Santa Barbara County, California. The area was nominated by the National Forest as a candidate RNA in 1986 to preserve an example of the Sierra Nevada mixed conifer forest for the South Coast Range Province.

The RNA as defined in this report covers 2963 acres (1199 ha). The boundaries differ from those originally proposed by the National Forest (map 5, and see discussion of boundaries in later section). The approximate center of the area is latitude 34°42' N and longitude 119°40' W. It lies within portions of sections 5, 6, 7, 8, and 9 T7N, R26W and sections 1 and 12 T7N, R27W, SBM. It is included within the San Rafael and Dick Smith Wilderness Areas except for the narrow right-of-way surrounding the Forest Service Road 9N11 (see maps 1 and 2).

Elevations range from 3600 ft (1108.8 m) at the confluence of the Sisquoc River and Big Pine Canyon to 6828 ft (2081.2 m) atop the summit of Big Pine Mountain. This represents a vertical range of 3228 ft (994.2 m).

Access:

The BPMRNA is accessible from the south via the gated forest road 9N11, known as the Big pine-Buckhorn Road. From Highway 101 in Goleta take State Highway 154 (San Marcos Pass Highway) north approximately 10.5 miles (16.9 km) north to the paved Forest Service Road 5N18 (Los Prietos Rd.) From this point it is approximately 3.5 miles (5.6 km) to the Los Prietos Ranger Station. From the Los Prietos Ranger Station continue on road 5N18 approximately 2 miles (3.2 km) to the junction with 9N11. Take this road approximately 1 mile (1.6 km) to the Upper Oso Campground. Road 9N11 is gated at two points before the RNA. First at the Upper Oso Campground, and second 11.5 miles (18.5 km) beyond. A Forest Service key must be obtained to travel on this road at all times beyond the second gate. The first gate is open to some motorized vehicles (motorcycles) and bicycles. The drive from Upper Oso Campground to the RNA is slow and steep in parts. It is approximately 32 miles (51.4 km) to the summit of the road (at the southern edge of the RNA) and requires about 1.5 hours to drive.

Once at the edge of the RNA, road 9N11 continues across the north slope of Big Pine Mountain for approximately 3 miles(4.8 km) to the site of the old (now dismantled) Alamar Guard Station and the intersection with the Alamar trail (27W07). This point is at the northeastern corner of the RNA. This road is only occasionally used and is traveled only by Forest Service or Forest Service authorized vehicles.

In addition to the road, two trails afford access to portions of the RNA. The Mission Pine Trail (28W01) follows the prominent ridgecrest west from the summit of road

9N11 to (and beyond) the southwestern corner of the area at West Big Pine Mountain. The portion of the trail within the RNA was once a vehicle route to the lookout on West Big Pine (now dismantled) and is easily traversed. The second trail, the Alamar Trail (27W07), follows the Sisquoc River westward from its beginnings. It affords access to the lower elevations of the RNA along its northern boundary, as it passes through Upper and Lower Bear Camps.

The true summit of Big Pine Mountain is reached by an old jeep trail, now difficult to find, branching off to the south from road 9N11 about 1 mile (1.6 km) north of the road summit. This jeep trail ascends the north slope of the mountain steeply, then follows the gradually sloping main summit crest for about a mile (1.6 km) to the east to the southeast corner of the RNA.

Aside from the previously mentioned routes, all travel within the interior of the RNA must be cross-country. Slopes are often steep and there are many small and large escarpments. Thick chaparral and low growing oak scrub also hamper travel at the mid and lower elevations. The target vegetation is open and close to the roads and trails, and thus is easily accessible.

PRINCIPAL DISTINGUISHING FEATURES

A part of the South Coast Ranges of California, and more specifically part of the San Rafael Mountains, Big Pine Mountain has one of the few well-developed examples of Sierran mixed coniferous forest (Holland 1986) in this physiographic province. The isolated stands of mixed conifer forest at Big Pine Mountain are separated from similar stands on San Rafael Mountain and Pine Mountain (also known as Reyes Peak, a part of the Transverse Range Province) by about 8 and 16 miles (12.8 and 25.7 km), respectively. The stands of mixed conifer forest are limited to the elevations above 5100 ft (1554.5 m) and are diverse and variable topographically and compositionally. The area is also notable for being adjacent to one of the last regular nesting localities of the Federally endangered California condor (*Gymnogyps californianus*)[1]. Until 1986, condors were regularly seen in the area. Other sensitive species and species of special concern (Steinhart 1990) known from the area include the spotted owl (*Strix occidentalis*), Cooper's hawk (*Accipiter cooperi*), sharp-shinned hawk (*Accipiter striatus*), golden eagle (*Aquillia chrysaetos*), prairie falcon (*Falco mexicanus*), purple martin (*Pogne subis*), yellow warbler (*Dendroica petechia*) and the Federally listed endangered peregrine falcon (*Falco peregrinus*).

In addition to the target vegetation the Big Pine Mountain RNA also contains a number of other plant communities including well-developed riparian vegetation along the Sisquoc River, bigcone Douglas-fir/canyon live oak forest (*Pseudotsuga*

[1] Bird taxonomy follows Peterson, R. T. 1990. A field guide to western birds, revised edition. Houghton-Mifflin, Boston.

macrocarpa/*Quercus chrysolepis*)[2], Coulter pine(*Pinus coulteri*)/chaparral vegetation, and such locally unique communities as shale barrens. At the highest elevation point within the South Coast Ranges, several species of montane animals and plants reach their terminus of distribution at Big Pine Mountain, otherwise, most of them are found to the east in the higher Transverse Ranges. The large size and elevation range of this candidate RNA are important to encompass the biotic variety in the region. It is likely that the riparian vegetation and the bigcone Douglas-fir/canyon live oak forest at the lower elevations will become additional target elements for the South Coast Range Province (see further discussion under Basis for establishment, and vegetation types).

The area also supports populations of at least two species of vascular plants considered rare by the California Native Plant Society: *Sidalcea hickmanii* ssp. *parishii* and *Allium monticola* var. *keckii* (Smith and Berg 1988).

The geology of the area is dominated by Eocene and Upper Cretaceous sedimentary rocks including massive sandstone and thinner beds of shale. The sandstone has eroded into spectacular cliffs along the southern boundary and along parts of Big Pine Canyon. Two major faults; the Rinconada Fault (also known as Sur-Nacmiento) and the Big Pine Fault, converge in the immediate vicinity of the area. Numerous smaller faults also occur in the RNA (Jennings et al. 1977).

JUSTIFICATION FOR ESTABLISHMENT

Mixed Coniferous Forest

This forest type, typical of the mid-montane areas of California is dominated by a similar mix of species throughout most of the state. These species include white fir (*Abies concolor)*, sugar pine (*Pinus lambertiana*), ponderosa pine (*P. ponderosa*), incense-cedar (*Libocedrus decurrens*), and, to a lesser degree Jeffrey pine (*Pinus jeffreyi*). In addition, many of these forests in northern California have Douglas-fir (*Pseudotsuga menziesii*) as a significant component. The southern California stands of mixed coniferous forest, including those at Big Pine Mountain, lack Douglas-fir, but may contain its southern California relative, bigcone Douglas-fir. In addition, the stands at RNA are without ponderosa pine, but do have Jeffrey pine.

The local mixed conifer forest is largely restricted to north-facing slopes at upper elevations. The largest single stand of this vegetation is on the north slope of Big Pine Mountain between 6000 ft (1828.8 m) and the summit ridge. Other smaller stands occur to the west on the north slopes of West Big Pine and intervening peaks, and also along the gently sloping valley bottom in the vicinity of Upper Bear Camp.

---

[2] Plant taxonomy follows Munz, P. A. 1974. A flora of southern California. University of California Press, Berkeley and Los Angeles, unless otherwise stated.

The forest is dominated by large individuals of the above mentioned species and, at best development, has an open understory with numerous large trees over 300 years old. The largest sugar pine measured was ca. 80 inches (2.03 m) dbh. Incense-cedar ranges up to 6 ft (1.8 m) dbh, and Jeffrey pine and white fir are represented by individuals to 5.5 ft (1.7 m) dbh. Most of the larger specimens have cat-face fire scars indicating repeated ground fires.

There is variation in the composition of the stands: some areas are dominated largely by white fir and sugar pine; some are without Jeffrey pine; some are dominated by Jeffrey pine; and some are without incense-cedar. The valley bottom stands near Upper Bear Camp differ structurally from the upper slope stands, with higher densities of saplings and young trees. Bigcone Douglas-fir does not mix regularly with the largest valley flat stand at Upper Bear Camp. However, it does occur in the steep ravine bottom stands where it ranges up to the lower limit of the upper slope, mixed conifer stands on north slopes.

Associated with the stands of mixed coniferous forest are animal species typical of this vegetation type throughout the state. Species such as the mountain chickadee (*Parus gambeli*) and white-headed woodpecker (*Picoides albolarvatus*) are both typical residents of the mixed conifer zone in California. These species are sedentary non-migrants. Their presence at Big Pine Mountain indicates relatively stable conditions within the mixed conifer zone. Although the local extent of this habitat is limited and is isolated by several miles from the nearest stands, it is large enough and well-developed enough to support such avian species. Conversely, certain mammal species characteristic of the California mixed conifer zone such as the golden-mantled ground squirrel (*Spermophilus lateralis*)[3] and various montane chipmunks (*Tamias* sp.) appear to be absent locally.

California Condor

This species has been the subject of much publicity in recent years not only because it it's the largest and rarest land bird in North America, but also because of the controversial decision of capturing and removing to zoos the lat remaining wild individuals for a captive breeding program. Prior to 1987 when the last individual was captured, the San Rafael Wilderness was one of the strongholds of the species.

Just 2.5 miles (4 km) west of the RNA is the Sisquoc Condor Sanctuary. This area of about 1200 acres (486 ha) was established in 1937 to protect one of the last known nesting sites of the species as well as bathing and roosting sites (information on file at Los Padres National Forest, S.O. Goleta). According to condor biologist Janet Hamber (1991) at the Santa Barbara Museum of Natural History, the cliffs just south of West

[3] Mammal tazomony follows Jamison and Peeters. 1988. California mammals, University of California Press, Berkeley and Los Angeles.

Big Pine and Big Pine Mountains have also been used by condors as nesting and roosting sites in the past (pers. comm.. January 1991). To quote her:

"enclosed within the boundary of the RNA is one condor nest site, one cliff roost site, and several large conifers that were used as roosts. The nest site was last active in 1980. The last breeding by the Santa Barbara pair was in 1985 on the south slopes of Big Pine Mountain, just outside the proposed RNA. In addition, there is another nest site, used in 1976, 1977, 1981, and 1984 on the south side of West Big Pine, just outside the RNA. The last two mentioned condor use areas also include several roost sites and drinking and probably bathing pools within the proposed boundary. A number of trees at the top of Big Pine Mountain and the ridge of West Big Pine were used as perch trees by the condors."

Some of the last wild condors were seen from the Alamar trail and from West Big Pine Mountain, both within the RNA, in July and December 1986 (notes from condor observation party in register atop West Big Pine Mountain). It is likely that if the re-introduction program is a success, that the BPMRNA will again become prime condor habitat (Janet Hamber, pers. comm.)

Rare Plants

Two species known from the area are members of the California Native Plant Society (CNPS) list of rare species (Smith and Berg 1988). The first is the mountain onion, *Allium monticola* ssp. *keckii*. Locally it appears to be restricted to the dark gray shale outcrops along the summit ridge between Big Pine and West Big Pine Mountains. It is a characteristic member of the local shale barrens association. The CNPS considers it to e a member of list 4 (a watch list for species of limited distribution, but not currently threatened or endangered). It is restricted to chaparral and lower montane coniferous forest in Las Angeles, Riverside, Ventura, Santa Barbara, and Orange Counties.

The second species, *Sidalcea hickmanii* ssp. *parishii*, is known from chaparral on Big Pine Mountain (Smith 1976). This species is a member of CNPS list 1b and is considered such because it is limited to a few restricted populations, it is endangered in a portion of its range, and it is endemic to California. It was not seen during the field work for this report. However, it should be expected in dry disturbed and sandy areas around fuelbreaks and fireroads along summits of mountains.

An additional rare taxa, the Santa Ynez false lupine (*Thermopsis macrophylla* var. *agnina*) is an endemic to the mountains of Santa Barbara County and is known from the Big Pine Mountain 7.5 minute topographic quadrangle (Smith and Berg 1988). It is considered a member of list 1b (plants of highest priority) because its occurrence is limited to a few highly restricted populations and it is endemic to California. It is not considered endangered at present. A plant which is apparently *T. macrophylla* var. *velutina* (photo 1) and not the rare taxon is locally common in openings in mixed

coniferous forest near the summit of Big Pine Mountain and forms colorful displays during early summer.

Animals of Special Concern

In addition to the endangered California condor, four other species of birds were seen in the area during the field work for this report, which are considered species of special concern by the California Department of Fish and Game (Steinhart 1990). These include the Cooper's hawk, seen flying twice over the coniferous forest at Upper Bear Camp. The golden eagle, seen four times in as many days primarily over the summit ridge and once perched atop a large sugar pine in the main stands of mixed conifer forest on the north slope of Big Pine Mountain; the spotted owl, heard one night in the valley bottom mixed conifer forest at Upper Bear Camp; and the yellow warbler seen several times along riparian stretches of the Sisquoc River. All four of these species are likely breeders in the area. Additional species of special concern observed within the RNA by Janet Hamber and associates of the Santa Barbara Museum of Natural History include; sharp-shinned hawk, Prairie falcon, and purple martin (a likely nester in local mixed coniferous forest). The Federally listed endangered peregrine falcon has also been seen the area.

Biogeographic Significance:

The RNA is near the meeting place for several major physiographic provinces. Although part of the South Coast Ranges, its high elevation and proximity to the high Transverse Ranges add a number of montane elements to the biota of the area, not typical of the South Coast Ranges. The area is also close enough to the Mojave Desert and xeric slopes surrounding the southern San Joaquin Valley so that several species typical of desert areas occur here. For example, single leaf pinyon pine (*Pinus monophylla*) occurs as scattered individuals along the ridgecrest west of West Big Pine. This locality, at approximately 119^{o}41' W longitude, is within two or three miles of the westernmost location and perhaps the closest location to the Pacific Ocean for this typical desert montane species in southern California (Griffin and Critchfield 1976). Other typical desert-montane species such as *Chrysothamnus nausiosus* and *Penstemon speciosus* are also found on the xeric upper ridges of the area.

Numerous montane elements also show their closet distributions to the ocean in this area. In addition to some of the typical dominant members of the mixed coniferous forest such as white fir and Jeffrey pine, other less conspicuous montane species are at or near their westernmost distributions in southern California. These include the following 41 species;

Allium burlewii
Amelanchier pallida
Arabis hirsuta var. *glabrata*

Arctostaphylos parryana
Chaenactis santolinoides
Calochortus invenustus
Castilleja applegatei
Crepis occidentalis var. *pumila*
Danthonia californica var. *americana*
Delphinium patens ssp. *montanum*
Eriastrum densifolium ssp. *austromontanus*
Eriogonum umbellatum ssp. *aridum*
Eriogonum wrightii ssp. *subscaposum*
Frasera neglecta
Fritillaria pinetorum
Gayophytum humile
Holodiscus microphyllus
Horkelia bolanderi ssp. *parryi*
Leptodactylon pungens ssp. *pulchriflorum*
Lotus nevadensis
Lupinus elatus
Lupinus latifolius var. *parishii*
Madia minima
Mimulus johnstonii
Osmorhiza chilensis
Penstemon grinnellii ssp. *scrophularioides,*
Penstemon speciosus
Phacelia imbricata ssp. *patula*
Phlox diffusa
Potentilla glandulosa ssp. *nevadensis*
Prunus virginiana var. *demissa*
Rubus leucodermis var. *bernardinus*
Sambucus caerulea
Sanicula graveolens
Silene lemmonii
Symphoricarpos parishii
Tauschia parishii
Thalictrum fendleri
Trifolium cyathiferum
Viola purpurea ssp. *xerophyta*
Zauschneria californica ssp. *latifolia*

As was mentioned in a previous section, birds such as the white-headed woodpecker and mountain chickadee are montane species absent from the entire South Coast Range Province, except the local high peaks in the San Rafael chain. Other more wide-ranging montane birds atypical of the South Coast Ranges are also known from the mixed coniferous forest, adjacent montane chaparral, and Jeffrey pine forest of the RNA.

These include the Cassin's finch (*Carpodacus cassini*), red crossbill (*Loxia curvirostra*), Clark's nutcracker (*Nucifuga columbiana*), Townsend's solitaire (*Miodynestes townsendii*), pygmy nuthatch (*Sitta pygmaea*), dusky flycatcher (*Empidonax oberholseri*), fox sparrow (*Spizella passerna*), and yellow-rumped (Audubon's) warbler (*Dendroica coronata*). Most of these species are thought to breed in the BPMRNA although they may not be permanent residents (either migrants or nomadic visitors).

Large Predators and Pristine Environment

Several species of large carnivorous mammals including black bear (*Ursus americanus*), mountain lion (*Felis concolor*), bobcat (*Lynx rufus*), Coyote (*Canus latrans*), and gray fox (*Urocyon cineroargentaeus*) were seen or noted by other observers within the RNA. Black bear were particularly conspicuous, seen twice in four days with numerous fresh sign noted throughout the area. In addition to the carnivores, a number of raptors also are known from the area including six species of owls, three hawks, three falcons, and the golden eagle (see appendix 2). The remoteness from civilization (more than 30 miles to the nearest settlement) and the location within a large, Federally established Wilderness Area ensure the near-natural predator-prey conditions necessary for maintaining healthy populations of these species.

Riparian Habitat

Some of the best remaining riparian vegetation in the South Coast Range Province occurs along the Sisquoc River (Ayn Martin, PSW RNA aquatic target element specialist and Mark Borchert, Ecologist, Los Padres N. F.; both pers. Comm.. 1989). Although the upper reaches of the river within the RNA are intermittent, several short stretches of permanently flowing water occur, and these are surrounded by well-developed riparian vegetation. This includes exceptionally large individuals of white alder (*Alnus rhombifolia*) up to 100 ft (30 m) tall and 32 inches (81 cm) dbh. Bigleaf maple (*Acer macrophyllum*), Fremont cottonwood (*Populus fremontii*), California bay (*Umbellularia californica*), and *Salix lasiandra* also occur as large trees. The understory is often well developed with stream clematis (*Clematis lingusticifolia*), stinging nettle (*Urtica holosericea*), *Satureja mimuloides*, *Artemisia douglasiana*, and *Stachys albens*. Further downstream a riparian woodland of coast live oak (*Quercus agrifolia*) surrounds the stream bottom.

The flowing sections of the stream also are home for numerous aquatic invertebrates and a population of presumed native rainbow trout (*Salmo gairdneri*) with some individuals up to at least 12 inches (30 cm) in length.

Vegetation Diversity

In addition to the target mixed conifer forest and the previously mentioned riparian vegetation, Big Pine Mountain RNA contains a number of other well-developed vegetation types. These include several distinct types of montane chaparral including bitter cherry and choke cherry (*Prunus emarginata* and *P. virginiana* var. *demissa*, respectively), Parry manzanita (*Arctostaphylos parryana*)-dominated montane chaparral, and deerbrush (*Ceanothus integerrimus*) scrub. True chaparral is represented at lower elevations by *Cercocarpus betuloides* and chamise (*Adenostoma fasciculatum*)-dominated types as well as by mixed phases co-dominated by several species. Also represented are well-developed bigcone Douglas-fir/canyon oak forests, some of which are transitional to mixed conifer forest. This forest type is well-developed enough to represent the target element for this vegetation type in the South Coast Ranges province (see appendix 3).

Another extensive vegetation type is Coulter pine/chaparral. The local stands of Coulter pine are largely even-aged, dating back to fires in the late 1930's or early 1940's. As with most stands in the chaparral matrix of the South Coast Ranges, these trees appear to have serotinous cones (Borchert 1985).

History of Scientific Research

The high elevation disjunct habitats and the presence of California condors in the area have proven attractive to a number of researchers. Several botanical and zoological expeditions to the area have been made. Thus, much information useful for further research has been accumulated. Most of this information is available through the staff at the Santa Barbara Museum of Natural History (SBMNH), 2559 Puesta del Sol Rd., Santa Barbara, CA 93105. Information on plants may be available from staff from the Santa Barbara Botanic Garden (in particular Clifton Smith and, for lichens, Cherie Bratt). Information on local vertebrate occurrence (noted in appendix 2) has been greatly augmented by Janet Hamber of the SBMNH.

PHYSICAL AND CLIMATIC CONDITIONS

The proposed RNA lies along the crest and the northern slopes of the eastern San Rafael Mountains, the southernmost and highest of the South Coast Ranges. The San Rafael Mountains are characterized by extremely steep south-facing escarpments (photo 2) dropping abruptly to the drainage of Santa Cruz Creek, and more gentle north slopes dropping to the Sisquoc River. The RNA occupies a portion of the north slopes of these mountains. Although more gradual than the southern escarpment, the slopes in the area range from moderate to steep, particularly in the lower Big Pine Canyon where escarpments more than 400 ft (122 m) high loom over the intermittent stream (photo 3). Several side branches of Big Pine Canyon dissect the slopes between West Big Pine Mountain and the base of the Big Pine Canyon cliffs. These canyons all exhibit stepped topography with relatively gradual slopes alternating with steep pitches and small waterfalls associated with bedding planes in the massive sandstone. The level summit

of Big Pine Mountain drops steeply down to the north, descending about 1500 ft (457 m) in less than a mile to the relatively level bench at Upper Bear Camp. From Upper Bear Camp the slopes again steepen as the budding Sisquoc River drops in a series of waterfalls to Lower Bear Camp (photo 4).

Due to the topographic relief of over 3000 ft (914 m), there are substantial climatic differences between upper and lower elevations in the RNA. Although no climatological records have been kept within the RNA, reasonable estimates of temperature and wind patterns may be obtained from records kept between 1971 and 1976 at Bluff Camp Guard Station at about 4400 ft (1341 m) approximately 1 air mile (1.6 km) due sough of the southern boundary of the RNA (data on file at Los Padres N. F., Goleta, CA). Table 1 summarizes the results from the four years of records kept at this station.

Table 1. Annual summary of wind and temperature data collected at Bluff Camp Guard Station 1972-1975, inclusive.

year	average wind direction	max. speed (mph)	av. temp. (^{o}F)	Max. temp. (^{o}F)	min. temp (^{o}F)
1972	west	15.5	56.3	101	6
1973	west	14.5	56.3	1.3	20
1974	northwest	17.5	58.7	98	24
1975	west	37.0	52.0	103	13

Temperatures at the upper elevations of the RNA are likely to average 6 to 8 ^{o}F colder than at Bluff Camp, while temperatures at the lower elevations along the Sisquoc River average probably 3 to 4 ^{o}F higher than Bluff Camp. During four days of field work for this ecological survey in early June 1989 temperatures at 6200 ft (1890 m) ranged from a high of 73 ^{o}F to a low of 31 ^{o}F.

Data from nearby and similarly oriented Pine Mountain (Borchert and Hibberd 1984) suggest that precipitation decreases rapidly from the crest to the north. According to Rantz (1972), average annual precipitation along the crest of the San Rafael Mountains in the vicinity of the RNA is somewhat above 30 inches (762 mm), ranging down to

about 25 inches (635 mm) along the upper Sisquoc River. Most precipitation falls between November and March.

Based on scanty information recorded at registers by hikers and mountain bikers visiting the summits of Big Pine and West Big Pine Mountains, snow falls regularly along the crest. At the summit of Big Pine Mountain, snow has been reported through April in some years and has been recorded as deep as 3 ft (about 91 cm) in December and 2 ft (61 cm) in drifts in early April. Judging from the *Letharia* lichen growth on mature conifers at the upper elevations, snow depth on north slopes average 12-18 inches (30-46 cm).

VEGETATION AND FLORA

The flora of the RNA is moderately rich. During the four days of field work for this report about 260 taxa of vascular plants were identified in the area (appendix 1); some additional species recorded for the RNA by Smith (1976) are listed there as well. It is likely that a number of other species occur in the area, particularly in the lower elevations of Big Pine Canyon and the Sisquoc River canyon. Floristic diversity in the area results from the well-balanced diversity of plant associations covering a range from low elevation chaparral and riparian to montane chaparral and mixed coniferous forest.

Vegetation types:

The vegetation map (map 3) is based on the Holland (1986) system of terrestrial plant communities. Following is a description of the major plant associations occurring in the BPMRNA. The code numbers following the association names are Holland type numbers. Table 2 shows acreages and equivalent habitat classification schemes.

Sierra Nevadan Mixed Coniferous Forest (84230, SAF 243): Despite the small extent of this vegetation in the RNA, it is remarkably diverse. This diversity in density, composition, and successional status rivals that of several other RNAs targeted for the same vegetation type in provinces where it is much more widespread, e.g., Doll Basin (Keeler-Wolf 1986a), Hall Canyon (Keeler-Wolf 1986b), Cub Creek (Taylor and Randall 1978), Sugar Pine Point (Palmer 1981).

The mixed coniferous forest at Big Pine Mountain occurs in fragmented stands (see map 3). Each of these stands has its own peculiarities. These range from tall, dense-canopied alluvial flat forests with a sparse understory dominated by saplings of white fir and incense-cedar to open ridgetop stands on shallow soil with low canopies and a shrubby understory dominated by chaparral shrubs and canyon live oak.

Even within individual stands there is considerable variation. This is particularly true of the largest stand on the north slope of Big Pine Mountain. This stand varies elevationally from stunted ridgetop forest dominated by Jeffrey pine and white fir through a mixed zone with incense-cedar and sugar pine in addition to the previous

species, to a transition forest with the bigcone Douglas-fir/canyon live oak in the low elevation ravines. This stand also varies from west to east at the same elevation, with the western side of the stand having a tendency for more mixed canopy composition and the eastern side canopy strongly dominated by white fir and sugar pine (photo 5).

Table 2. Area by cover types for BPMRNA with code numbers for Holland (1986), SAF (Eyre 1980), and Kuchler (1966) classifications

	% total	acres	hectares
HOLLAND TYPES			
Northern Mixed Chaparral (37110)	21.2	640	259.0
Montane Chaparral (37500)	5.2	155	62.7
Valley and Foothill Grassland (42000)	0.3	9	3.6
Montane Riparian Forest (61500)	1.0	29	11.7
Canyon Live Oak Forest (81320)	18.0	532	215.3
Coulter Pine Forest (84150)	14.2	420	170.0
Bigcone Spruce-Canyon Oak Forest (84150)	10.3	306	123.8
Sierran Mixed Coniferous Forest (84230)	22.0	653	264.3
Jeffrey Pine Forest (85100)	2.6	78	31.6
Unclassified	4.8	141	57.1
Total	100.0	2963	1199.0
SAF COVER TYPES			
Canyon Live Oak (245)	18.0	532	215.3
Sierra Nevada Mixed Conifer (243)	22.0	653	264.3
Jeffrey Pine (247)	2.6	78	31.6
Unclassified	57.4	1700	688.0
Total	100.0	2963	1199.0
KUCHLER TYPES			
Mixed Conifer Forest (5)	24.6	731	295.8
California Oakwoods (26, in part)	18.0	532	215.3
Chaparral (29)	26.8	794	321.3
California Steppe (41, in part)	0.3	9	3.6
Unclassified	30.3	897	363.0
Total	100.0	2963	1199.0
OTHER UNCLASSIFIED TYPES			
Shale Barrens		29	11.7
Rock Outcrop		112	45.3
(added to previous Holland types this constitutes 100% coverage)			

Vegetation was sampled in the largest stand on Big Pine Mountain (2400 sq. m sampled), and in the alluvial flat stand near Upper Bear Camp (1500 sq. m sampled).

The best-developed upper slope stands occur on north-facing slopes and are characterized by an open canopy dominated by white fir with lesser amounts of Jeffrey pine, incense-cedar and sugar pine. All four principal species may attain sizes of greater than 5 ft (1.52 m) dbh. Canopy height is variable depending upon exposure ranging from 50-60 ft (15-18 m) along the ridgetops to ca. 125 ft (38 m) on sheltered slopes. The understory of these upper slope forests is extremely open and sparse (photo 6). Herb and shrub cover averages less than 5% and saplings and seedlings of conifers average only about 100/ha with white fir dominant. Tables 3 through 5 show sampling results for the main upper slope stand on Big Pine Mountain.

Table 3: Sampling data for trees on 24 10 x 10 m plots between ca. 6080 and 6800 ft on north and northwest facing slopes of Big Pine Mountain.

Species	density (per ha)	frequency	cover (m^2/ha)	rel. den.	rel. freq.	rel. cover	importance value
whiter fir	245.8	0.917	70.13	0.711	0.537	0.645	189.3
incense-c	41.7	0.333	22.00	0.121	0.195	0.202	51.8
Jeffrey p	54.2	0.417	16.00	0.157	0.244	0.147	54.8
Sugar pine	4.2	0.042	0.63	0.012	0.025	0.006	4.3
Totals	345.8	1.709	108.76	1.000	1.000	1.000	300.0

Table 4: Density and frequency values of saplings and seedlings on the same 24 plots sampled in Table 3.

Species	density/ha	frequency
White fir	66.7	0.333
Canyon live oak	20.8	0.208
Jeffrey pine	4.2	0.042
Sugar pine	4.2	0.042
Totals	95.9	0.625

Table 5: Herb and shrub cover and frequency on the same 24 plots sampled in Table 3 and 4.

Species	frequency	mean % cover
Lupinus elatus	0.58	1.88

Angelica tomentosa	0.33	0.98
Elymnus glausus	0.17	0.21
Symphoricarpos parishii	0.08	0.16
Erigeron foliosus	0.25	0.13
Amorpha californica	0.04	0.13
Eriogonum nudum	0.45	0.08
Tauschia parishii	0.04	0.08
Arceuthobium campylopodum	0.04	0.08
Arabis remanda	0.04	0.08
Gayophytum diffusum parvifolium	0.21	0
Phacelia curvipes	0.21	0
Claytonia spathulata	0.13	0
Galium aparine	0.13	0
Mentzelia Montana	0.13	0
Viola purpurea xerophyta	0.08	0
Bromus marginatus	0.08	0
Ribes roezlii	0.08	0
Silene lemmonii	0.08	0
Allophyllum gilioides	0.04	0
Chenopodium sp.	0.04	0
Cryptantha intermedia	0.04	0
Erysimum capitatum	0.04	0
Gilia modocensis	0.04	0
Lotus nevadensis	0.04	0
Phacelia distans	0.04	0
Pyrola picta aphylla	0.04	0
Sambucus caerulea	0.04	0
Thermopsis macrophylla	0.04	0
Zauschneria californica latifolia	0.04	0
Total mean cover		3.79

Although the east-central portion of the main upper-slope stand was not sampled, it clearly has a less mixed aspect than the remainder of the stand with virtually no incense-cedar and Jeffrey pine. This portion is co-dominated by white fir and sugar pine. Sugar pine in particular is 4 to 5 times more abundant in the canopy than in other portions of the main stand (see photo 5). Site factors are probably largely responsible for this difference from the remainder of the stand; this area occupies relatively steeper and more northerly-facing slopes than the remaining stand, and occurs between 5800 and 6500 ft (1768-1981 m). This white fir - sugar pine phase resembles the forest type of the same name described for Pine Mountain (Reyes Peak) by Borchert and Hibberd (1984). They found that this type also was strongly restricted to steep (62 percent), protected slopes between 5840 and 6266 ft (1780-1910 m).

In general, the most ubiquitous species in the main stand is white fir. Jeffrey pine is moderately restricted to xeric sites, where it grades into relatively pure Jeffrey pine forest (see later discussion of Jeffrey pine forest) on exposed ridges and shallow shale or sandstone soils. Incense-cedar is largely restricted to sheltered mesic ravines or sites with relatively deep soils, and sugar pine is best represented on steep north slopes.

The open nature of the canopy and understory of this upper slope mixed coniferous forest has assisted in its persistence. The surrounding lower slope vegetation is frequently dense chaparral or canyon oak forest, both which typically carries crown fires. The numerous cat-face scars on the mature conifers (up to 20 ft, 6 m tall), attest to the presence of ground fire in the main body of the mixed coniferous forest. The open canopy and understory prevent spread of crown fire. The abrupt line of demarcation along the summit of Big Pine Mountain between chaparral on the south slope and coniferous forest on the north demonstrates the divergent effects of fire in these two communities (photo 7).

Pre-European fire frequency of the main stand of mixed coniferous forest on Big Pine Mountain averaged one fire every 12 years. This frequency was based on the analysis of several fire scars by Nancy Sandberg (1989) sampled on the north slope of Big Pine mountain adjacent to the Big Pine-Buckhorn road.

The other large upper-slope stand occurs midway between Big Pine and West Big Pine Mountains. It is structurally similar to the western side of the main stand with a core area dominated by white fir and sugar pine up to 100 ft (31 m) tall and 52 inches (132 cm) dbh. However, it is edaphically restricted by surrounding sterile shale and sandstone outcrops. Conifers, especially incense-cedar and sugar pine (photo 8), adjacent to these outcrops are stunted both at upper elevations and at more sheltered lower sites. This stand also seems to have suffered more from the effects of recent drought than the main stand on Big Pine Mountain. Several recently dead and dying white fir and sugar pine were noted in June 1989. Reproduction in the core of this stand appears better for white fir and sugar pine than in most of the main stand, although incense-cedar and Jeffrey pine are poorly represented by saplings and seedlings.

The westernmost stand of mixed coniferous forest occurs at West Big Pine. It is an extremely open stand dominated by Jeffrey pine with scattered white fir and sugar pine. There is no incense-cedar. The understory is dominated by scrubby canyon live oak mixed with chaparral species such as *Arctostaphylos glandulosa*, *Garrya flavescens*, and *Cercocarpus betuloides*, and is broken with numerous sandstone outcrops. The trees are all relatively stunted and average about 50 ft (15 m) tall.

The low elevation alluvial bench stand at Upper Bear Camp is connected to the main Big Pine Mountain stand via several fingers of forest descending steep ravines to the Upper Bear Camp area. These ravine forests are transitional with bigcone Douglas-

fir/canyon live oak and do not appear to contain Jeffrey pine, although they do have individuals of white fir, sugar pine, and incense-cedar.

The sheltered Upper Bear Camp stand is higher in tree density and basal area, has a higher canopy, and a higher density of saplings and seedlings than the upper-slope stands. Tables 6 and 7 summarize the sampling effort for this forest.

Table 6: Tree sampling data on 15 10 x 10 m plots in mixed coniferous forest on alluvial bench near Upper Bear Camp, Big Pine Mountain RNA.

Species	density (per ha)	frequency	cover (m^2/ha)	relative density	relative freq.	relative cover	importance value
white fir	340.0	0.867	41.86	0.422	0.317	0.335	107.4
incense-c	233.3	0.733	47.84	0.289	0.268	0.383	94.0
canyon oak	173.3	0.667	3.75	0.215	0.244	0.030	48.9
Jeffrey p	26.7	0.267	20.55	0.033	0.098	0.165	29.6
sugar pine	6.7	0.067	10.78	0.008	0.025	0.086	11.9
big-l maple	13.3	0.067	0.17	0.017	0.025	0.001	4.3
coast l oak	13.3	0.067	0.01	0.017	0.025	0.000	4.2
totals	806.6	2.735	124.96	1.001	1.001	1.001	300.3

Table 7: Herb and shrub frequency and cover on 15 10 x 10 m plots in mixed coniferous forest at Upper Bear Camp, Big Pine Mountain RNA

Species	frequency	mean % cover
Amorpha californica	0.20	0.33
Prunus virginia demissa	0.13	0.33
Erigeron foliosus	0.13	0.07
Solidago californica	0.20	0.07
Linanthus androsaceus	0.13	0.20
Eriogonum nudum	0.20	0
Clarkia rhomboidea	0.13	0
Gayophytum diffusum parvifolium	0.13	0
Lotus sp.	0.13	0
Phacelia curvipes	0.13	0
Angelica tomentosa	0.07	0
Calyptridium monandrum	0.07	0
Corethrogyne filaginifolia	0.07	0
Marah fabaceus agrestis	0.07	0
Mimulus johnstonii	0.07	0
Total mean cover		1.00

The seedling and sapling density averages 287/ha with white fir averaging 140, incense-cedar 47 and canyon live oak 100 per hectare. In addition to saplings and seedlings, there are higher densities of pole-size individuals than in the upper-slope stands (photo 9). The presence of canyon live oak and scattered occurrence of mesophilic valley bottom species such as bigleaf maple and coast live oak are indicative of the different environment of the Upper Bear Camp stand. The low cover provided by shrubs and herbs attests to the relatively dense cover of the canopy. There is a strong correlation between understory density and openness of plot.

Growth rates of white fir appear more rapid at the Upper Bear Camp stand than on upper slopes. One individual, 26.5 inches (67.3 cm) dbh, growing at the edge of the small grassy glade was 101 years old. In contrast, a 25 inch (63.5 cm) dbh white fir on the main north slope stand of Big Pine Mountain was 201 years old. In outlying portions of the alluvial flat stand most of the old canopy trees were destroyed perhaps 110 years ago as a result of a crown fire. White fir has rapidly colonized these areas with a cohort of 100-year-old trees (photo 10).

As with the upper slope stands, the core of the Upper Bear Camp stand has a long history of ground fire. Surrounding upper slope vegetation is dominated by canyon live oak and Coulter pine with some chaparral on more xeric exposures. The restriction of the mixed coniferous forest to the gently sloping low-lying area around Upper Bear Camp is probably a result of several factors including the differential effect of fire one slope position and the climatic conditions being marginal for maintenance of mixed coniferous forest at this low elevation.

Canopy height of the Upper Bear Camp stand is substantially taller than that of any of the upper-slope stands. Several old individuals of Jeffrey pine attain heights of more than 170 ft (52 m), and may be in excess of 450 years old.

Successional relationships in the RNA mixed coniferous forest have already been mentioned. They vary from stand to stand. White fir appears to be the overall dominant in all age classes in the main body of most stands. It is the most active colonizer of the canyon live oak and chaparral habitats adjacent to the main north-slope stand as well as the alluvial flat stand. Crown fire frequency and, to a lesser degree, climatic intolerance are probably largely responsible for the inability of the upper-slope and alluvial flat stands to join on the lower north slopes of Big Pine Mountain. The other upper-slope stand between Big Pine and West Big Pine is largely edaphically restricted by the surrounding shale and sandstone outcrops. Jeffrey pine forest borders it on sandstone, whereas there is an abrupt altern with shale barrens on its west side. Jeffrey pine appears to be the most successful reproducer at the margins of this stand, although white fir is most successful in the interior.

Where mixed coniferous forest contacts bigcone Douglas-fir/canyon live oak forest in ravines and canyon bottoms white fir and especially incense-cedar are the most abundant mixed conifer species. Local clumps of incense-cedar may dominate in mesic or hydric sties well into the canyons, up to 1000 ft (305 m) below the main mixed coniferous forest belt. The shade-intolerance of Jeffrey pine and to a lesser extent, sugar pine is an important factor governing their scarcity in the canyon bottoms.

One of the intriguing local features of the mixed coniferous forest is the apparent absence of ponderosa pine. Although Griffin and Critchfield (1976) show the species in the vicinity of Big Pine Mountain, I did not locate a single specimen in the RNA. Several miles to the east on Reyes Peak it does occur, and its ecological role has been studied (Borchert and Hibberd 1984). Apparently it has a bimodal distribution there, with a high and a low elevation zone of occurrence. These two zones have similar trends in that the species first becomes abundant at low elevations on northerly slopes and gradually shifts its abundance to southerly slopes at the higher elevations of both zones. Borchert and Hibberd found that xeric high elevation sites, ostensibly suitable or ponderosa pine, are occupied by Jeffrey pine. This suggests that Jeffrey pine out-competes ponderosa in the colder, drier high elevation habitats typical of southern California mountains. This appears to be true at RNA, as well. In the past, if present at RNA, ponderosa pine was likely out-competed by Jeffrey pine on the ridgetops. Aside from the ridgetops, there is little remaining favorable habitat for ponderosa pine in the study area. It requires much sun for early stages of growth, and the shady north-facing aspect of virtually all of the mixed conifer forest favors domination by white fir, sugar pine, and incense-cedar.

Northern Mixed Chaparral (37110):

This classification is broad and somewhat artificial, encompassing all chaparral types found in the lower and mid-elevation parts of the RNA. Although there are stands dominated by several different species, the majority of these are not monospecifically dominated. Hence, there is little pure chamise (*Adenostoma fasciculatum*), pure manzanita (*Arctostaphylos* spp.), or scrub oak (*Quercus dumosa*) chaparral. Thus, the general title of northern mixed chaparral is suitable until further detailed classification can be conducted. Ranging from low to high elevations, several phases are apparent.

At the lowest elevations on steep southwest-facing exposures chamise tends to dominate in a mixed chaparral with *Arctostaphylos glauca*, *Salvia leucophylla*, *Eriogonum fasciculatum*, *Leptodactylon californicum*, *Lotus saoparius*, *Ephedra viridis*, *Mimulus longiflorus*, and *Ceanothus* sp. (photo 11). At similar elevations on less exposed rocky sites (westerly and easterly aspects) *Cercocarpus betuloides* is often dominant with chamise, *Prunus ilicifolia*, *Ceanothus leucodermis*, *Arctostaphylos glauca*, and *Quercus dumosa*. At low elevations on northeast aspects the chaparral is composed of *Artostaphylos glauca*.

One thousand feet higher, on northeast and northwest aspects, chaparral is typically dominated by *Cercocarpus betuloides*, *Quercus dumosa*, *Garrya flavescens* ssp. *pallida*, and *Arctostaphylos glandulosa* with *Yucca whipplei*, *Marah fabaceus* var. *agrestis*, and *Lonicera interrupta*. In some areas other scrubby oaks besides *Q. dumosa* may become important including *Q. wislizenii* var. *fructescens* and a shrubby form of coast live oak. At higher elevations the chaparral assumes a more montane character with shrubby canyon live oak frequently dominating along with lesser cover of *Arctostaphylos glandulosa*, *Cercocarpus betuloides*, and *Garrya flavescens*. This latter type may range up to the crest of the mountains as near West Big Pine.

Canyon Live Oak Forest (81320)

This forest is widespread on the mid- and upper slopes, and ranges from below 400 ft to over 6400 ft (1219-1950 m). AT the lower elevations as in lower Sisquoc and Big Pine canyons it is restricted to northerly facing concave slopes, often adjacent to riparian vegetation. However at upper elevations it may occur on steep westerly and easterly facing exposures. The canopy height and stem size varies depending upon fire history and local site conditions. In general, the best developed trees are in ravines and low-lying concavities where they are single-trunked with dbh's up to 3.5 ft (1.1 m) and heights of 90 ft (27 m). On upper open slopes they are typically scrubby often only 10-15 ft (3-4 m) tall with multiple stems only a few inches in diameter. Modal mid-slope stands are typically 20-30 ft (6-9 m) tall with trunks 10-12 inches (25-30 cm) in diameter (photo 12).

Crown cover is usually high except on extremely steep slopes verging on cliff and rock outcrop. The understory in typical stands is poorly developed, consisting largely of duff with occasional sprigs of *Elymus glaucus* and other herbs. Stem age of the majority of these stands is about 50 years, dating back to the last major fire in the area.

Coulter Pine Forest (84140)

Borchert (1984), in their study of Coulter pines in the South Coast Ranges, has defined several association types with Coulter pine as the dominant canopy species. In the RNA two main types exist: the Coulter pine/chaparral, and the Coulter pine/canyon live oak. By far, the most extensive in the RNA is the Coulter pine/chaparral. This phase occupies the open slopes and ridges of the mid elevations from about 4800 to 6000 ft (1463-1829 m). It is dominated by an even aged stand of Coulter pine averaging 50-60 ft (15-18m) tall and approximately 50 years old. The trees are often dense, averaging 800-1000/ha (photo 13) and are 6-12 inches (15-30 cm) dbh. The understory is variable but dominated by chaparral shrubs, particularly *Arctostaphylos glandulosa*, *Quercus dumosa*, *Q. wislizenii* var. *fructescens*, *Cercocarpus betuloides*, and *Garrya flavescens* var. *pallida*. The Coulter pine/chaparral type is the dominant type in the Big Pine Canyon drainage. In this area it tends to form a variable belt between the mixed chaparral of the lower slopes and the canyon live oak forest of the upper-slopes (photo 14).

The Coulter pine/canyon live oak phase is the predominant type on the north slopes of Big Pine Mountain. It occurs in smaller stands, and pine densities are not as high as in the previous phase. The associated canyon live oaks are generally small multi-trunked individuals averaging 15-20 ft (5-6 m) tall with stems 5-8 inches (13-20 cm) in diameter. The understory is sparse with few herbs and shrubs.

Both phases may have occasional larger specimens of Coulter pine. These large individuals usually occur in relatively sheltered ravines or rocky areas. One such individual was 75 years old, 27 inches (69 cm) dbh and about 71 ft (21.6 m) tall. Such trees pre-date the last major fire responsible for the proliferation of 50-year-old trees. Some exceptionally large Coulter pines exist in valley bottom locations adjacent to the Upper Bear Camp stand of mixed coniferous forest. One such tree, marked with an aluminum tag, may be one of the largest Coulter pines in the region. It measures 59 inches (1.5 m) dbh and about 125 ft (38 m) high. It occurs along the Alamar Trail a few yards north of Upper Bear Camp at 5100 ft (1555 m).

The dense stands of Coulter pine in the RNA are serotinous-coned, as described in Borchert (1985). Based on branch whorl counts, the 45- to 50-year-old trees have cones which persist for an average of about 12 years on the main stem before fully opening, dropping, or disintegrating. Some closed cones up to 15 years old were seen on 50-year-old trees. Tightly closed cones were commonly seen that were 6 to 8 years old, and virtually all cones younger than 6 years were tightly closed. Stand-immolating fires burn over extensive areas of both chaparral and canyon live oak types. Borchert (1985) argues convincingly for Coulter pine cone serotony as an adaptive mode of post-fire reproduction in such habitats.

Bigcone Douglas-fir/Canyon Oak Forest (84150):
This forest is restricted to ravines and steep concave slopes between about 4200 and 5700 ft (1280-1737 m). Thus, individual stands are usually small and linearly oriented along a topographic gradient. The most extensive stands occur along the several branches of Big Pine Canyon. The dominant bigcones in such locations have rough, deeply furrowed bark and may be up to 6 ft (1.8 m) dbh and 130 ft (39 m) tall. Understory trees of canyon live oak may be up to 3 ft (91 cm) dbh and 60 ft (18 m) tall. The typical structure is an open canopy of bigcone averaging 40-50 percent closure with a relatively dense subcanopy of canyon oak (photo 15).

Bigcone Douglas-fir is restricted to steep canyon bottoms or ravines. Although it occurs immediately adjacent to the alluvial flat mixed coniferous forest at Upper Bear Camp, it does not descend from the steep slopes and intermingle with the mixed conifers. Neither does it ascend the north-facing ravines to the more open upper slopes of Big Pine Mountain. There is a farily distinct transition between the upper slope mixed coniferous forest and the bigcone Douglas-fir/canyon live oak type. The open understory of the former abuts the more closed and heavily vegetated understory of the latter. Apparently this restriction is largely due to susceptibility to crown fire. The

sheltered sites dominated by bigcone Douglas-fir are among the most highly protected from fire of any in the RNA.

According to McDonald and Littrell (1976) the bigcone Douglas-fir/canyon live oak community is a well-defined ecological unit which may have changed little over thousands, if not millions of years. Evidence of its relict nature lies in its mesic moisture requirements within a relatively xeric climatic zone. Fossil evidence of a similar type of forest occurs in Pliocene and Pleistocene deposits.

The community is apparently one of the least commonly fire-affected types in the Southern California lower montane area. McDonald and Littrell found little evidence of major disturbance in any of their well-developed stands. Their results indicate that at low elevations the community is limited to mesic ravines and northerly-facing slopes. At upper elevations the community may be found on S-facing exposures without requiring canyons, streams, and draws. This latter situation does not occur locally at BPMRNA.

The specific adaptations for fire-resistance (very thick, firm bark and the ability to resprout from boles and major branches) in *P. macrocarpa* are only evident in relatively large and old specimens. The species reproduces best in the semi-shade of forested situations. However, it grows relatively slowly under these conditions and increases its growth rate following the topping of the surrounding canyon live oak canopy (which takes 40-70 years). Thus, it takes many years of little or no disturbance before an area may come to be dominated by bigcone Douglas-fir. Conversely, the rapid resprouting ability of canyon live oak enables it to dominate quickly after a burn.

In addition to the two principal species, several other tree species may occur in this association. As has been discussed, the upper elevation portions of this type may have a mix of mixed conifer species such as white fir, sugar pine, and incense-cedar. White fir and sugar pine are not usually abundant and typically occur as scattered individuals. However, incense-cedar is relatively common especially close to the ravine bottoms, where it may locally dominate (photo 16). Bigleaf maple and California bay (*Umbellularia californica*) are also locally common in the ravine bottoms. Occasional large Coulter pines and individual sapling and pole-size specimens not germinating as a result of fire also occur. The understory is sparse, usually rocky and covered with duff. It is commonly dominated by poison oak (*Toxicodendron diversilobum*) and shrubby specimens of canyon live oak. Other species include *Arnica discoidea*, *Bromus marginatus*, and *Carex multicaulis*.

The large bigcone Douglas-firs in this association may be up to 400 years old. Joel Michaelson and others (Barbour et al. 1991) conducted a detailed climatological study of the past 400 years on tree ring analysis based on bigcone Douglas-fir in central Santa Barbara County. The large single-stemmed canyon oaks may be between 200 and 300

years old. An individual, 2.5 ft (76.2 cm), along the trail near Lower Bear Camp was about 225 years at breast height.

Montane Chaparral (37500?):
As with the northern mixed chaparral, this is an aggregation of types not strictly defined by a single set of dominants. The montane chaparral of Big Pine Mountain is, however, more easily divided into distinct types than the previous chaparral typical of lower elevations. Three main phases occur: 1) the parry manzanita phase; 2) the *Ceanothus integerrimus* phase; and 3) the bitter cherry-chokecherry (*Prunus emarginata-P. virginiana* var. *demissa*) phase.

Parry manzanita dominated or codominated with scrub oak, low canyon live oak, *Cercocarpus betuloides*, *Garrya flacescens* var. *pallida*, *Artostaphylos glandulosa*, *Amorpha californica*, and *Ceanothus integerrimus*. *Ribes roezlii*, *Amelanchier pallida*, *Chrysothamnus nausiosus*, and *Eriogonum wrightii* also are present. In some areas the shrubby oak is *Quercus wislizenii* var. *fructescens* instead of *Q. dumosa* or *Q. chrysolepis*. Herbs are scarce and include *Stephanomeria chicoracea*, *Arabis perennans*, *Lupinus excubitus* ssp. *austromontanus*, and *Poa scabrella*. This type of chaparral is scattered on shale and sandstone outcrops at the head of the Big Pine Canyon drainage. It is closely associated with Jeffrey pine and mixed coniferous forest and frequently occurs adjacent to shale barrens (see following discussion) or sandstone outcrops. The shrubs tend to occur as dense islands surrounded by patches of open ground and individual patches rarely cover more than a few acres. This type is transitional with the upper elevation form of northern mixed chaparral in several areas on the north slopes of West Big Pine.

The *Ceanothus integerrimus* scrub is also closely associated with mixed coniferous forest. However, it is less of an edaphic climax community than the parry manzanita phase. It occurs in several patches adjacent to the main stand of mixed coniferous forest on Big Pine Mountain where it occupies a transitional position between the mixed conifer forest and adjacent canyon live oak association. It appears to occupy a dynamic zone between the two associations and may be indicative of secondary succession following the most recent major fire in the area. There are typically high numbers of saplings of white fir associated with these areas.

Besides the dominant *C. integerrimus*, other species include *Prunus virginiana* var. *demissa*, and *Amorpha californica*. Openings in the shrubs may be dominated by *Thermopsis macrophylla* and *Angelica tomentosa*.

The third major type of montane chaparral is strongly dominated by bitter cherry with some choke cherry. It is the most localized of the three, restricted to about 10 ha on the upper northwest slope of Big Pine Mountain. The patch is bisected by the Big Pine-Buckhorn Road. This is the tallest of the three types averaging 10-15 ft (3-4 m) in height and is also the most continuously dense phase. It occupies relatively steep slopes

at the base of a very rocky, steep portion of mixed coniferous forest just below the summit of the mountain. There is little else associated with the dense stand, although *Amelanchier pallida* occurs as isolated shrubs and *Ceanothus integerrimus* forms a border on the north side of the patch near the edge of the mixed coniferous forest. As with the *Ceanothus integerrimus* type, this type appears to be successional with numerous pole size and larger white fir and sugar pine associated with it.

Rock Outcrop (No Holland equivalent):
Rock outcrops occur in many parts of the BPMRNA. The most spectacular are the cliffs in the lower Big Pine Creek drainage, but several more gently sloping outcrops occur in the upper reaches of Big Pine Canyon up to the crest. All of these are made up of massive sandstone. The flora of these outcrops appears relatively consistent throughout the RNA. Cover is restricted to scattered plants in cracks and crevices. Typical species include *Dudleya cymosa* ssp. *minor*, *Eriogonum saxitile*, *Zauschneria californica*, *Keckiella brevifolia*, *Cirsium californicum*, *Mimulus longiflorus*, *Eriogonum wrightii*, *E. umbellatum* (upper elevations), and *E. fasciculatum*.

Jeffrey Pine Forest (85100):
This open forest is closely associated with the mixed coniferous forest of the upper elevations, but typically occupies shallower soil, or more exposed positions on exposed ridges and outcrops. Because of the harsh conditions, trees are usually stunted and much shorter than Jeffrey pines within the main body of the mixed coniferous forest (photo 17). The average size of dominant individuals is roughly 3 ft dbh (1 m) and 50 ft (15 m) tall. Most of the dominant Jeffrey pines appear to be moderately old (200-300 years). However, occasional large specimens may be twice as old.

Jeffrey pine stands occupy two main environments; relatively deep sandy soils atop the summit of Big Pine Mountain, and very shallow rocky soils over shale or sandstone in more sheltered, gradually-to-moderately sloping northerly exposures. The latter situation was sampled immediately west of the roadcrest near the junction of the Big Pine-Buckhorn Road and the Mission Pines Trail. Tables 8 and 9 summarize the results.

The most common associate with Jeffrey pine on the rocky sites is canyon live oak. This species typically occurs as small multi-trunked individuals with stems averaging about 5-6 inches (13-15 cm) dbh and heights of 15-20 ft (4.5-6 m). White fir and sugar pine are scattered, mostly represented by young individuals. Reproduction is typically poor for all species except canyon oak (142 seedlings and saplings/ha). Jeffrey pine and other conifer saplings and seedlings average less than 15/ha. Aside from the scattered subcanopy of canyon live oak, several montane chaparral shrubs such as *Symphoricarpos parishii*, parry manzanita, *Quercus dumosa*, *Holodiscus microphyllus*, and *Ceanothus integerrimus* occur in the understory. Table 9 lists most of the common herb species.

A different set of circumstances characterizes the Jeffrey pine forest atop Big Pine Mountain. This area is underlain by deeper, sandy soil and lies astride the main ridge, separating the main body of the mixed coniferous forest from extensive stands of chaparral on the south slopes outside of the RNA. The understory is dominated by herbaceous species and there are few rock outcrops (photo 18). The dominant trees are stunted ranging from 40 to 60 ft (12 to 18 m) tall, but attain girths of 3-4 ft (91-121 cm). The average age of the canopy is estimated at 200 years, although occasional ancients with deep cat-face scars up to 20 ft (6 m) high are substantially older. Reproduction appears somewhat more frequent than in the rocky phase.

Table 8: summary of data for trees on seven 10 x 10 m plots sampled in Jeffrey pine forest near junction of Big Pine-Buckhorn Road and Mission Pines Trail 6500-6300 ft Big Pine Mountain RNA.

Species	density (per ha)	frequency	cover (m^2/ha)	rel. den.	rel. freq.	rel. cover	importance value
Jeffrey p	300.0	1.000	38.44	0.429	0.500	0.795	172.4
canyon oak	342.9	0.571	7.35	0.490	0.286	0.152	92.8
white fir	42.9	0.286	1.17	0.061	0.143	0.024	22.8
sugar pine	14.3	0.143	1.42	0.020	0.072	0.029	12.1
totals	700.0	2.000	48.38	1.000	1.000	1.000	300.0

Table 9: Frequency and cover of herbs and shrubs on seven 10 x 10 m plots in Jeffrey Pine forest near junction of Big Pine-Buckhorn Road and Mission Pines Trail, 6500-6300 ft, Big Pine Mountain RNA

Species	frequency	mean % cover
Symphoricarpos parishii	0.71	1.43
Arctostaphylos parryana	0.14	1.00
Viola purpurea *xerophyta*	0.71	.57
Galium andrewsii	0.57	0.43
Eriogonum wrightii	0.28	0.28
Vicia americana	0.43	0.14
Ceanothus integerrimus	0.14	0.14
Garrya flavescens	0.14	0.14
Keckiella breviflora	0.14	0.14
Lupinus excubitus austromontanus	0.14	0.14
Eriogonum umbellatum	0.28	0
Poa scabrella	0.28	0
Sanicula graveolens	0.28	0
Silene lemmonii	0.28	0

Tauschia parishii	0.28	0
Balsamorhiza deltoidea	0.14	0
Bromas tectorum	0.14	0
Chrysothamnus nausiosus	0.14	0
Dichelostemma pulchella	0.14	0
Erigeron foliosus	0.14	0
Eriophyllum confertiflorum	0.14	0
Lupinus elatus	0.14	0
Rhamnus californica tomentella	0.14	0
Sitanion hystrix	0.14	0
Tauschia hartwegii	0.14	0
total cover		4.41

The understory flora is composed of *Lupinus elatus*, *L. excubitus* ssp. *austromotanus*, *Agoseris retrosa*, *Dichelostemma pulchella*, *Solidago californica*, *Bromus tectorum*, *Zauschneria californica latifolia*, *Eriogonum nudum*, *Phacelia curvipes*, *Gilia modocensis*, *Eriogonum hirtiflorum*, *Gayophytum diffusum parviflorum*, *Madia elegans*, *Calystegia malacophylla* ssp. *pedicelluta*, and *Erysimum capitatum*. These species may cover up to 35 of the understory.

In some areas along the ridge, young Jeffrey pines have colonized the south-facing chaparral. However, no older individuals occur, suggesting that frequent crown fire prevents further extension of the forest southward. The ridgetop Jeffrey pine forest presents an effective barrier to crown fire sweeping up from the south slope, with its open understory and widely spaced trees.

Montane Riparian Forest (61500):
The riparian associations at the Big Pine Mountain RNA are patchily distributed, ranging from the lowest elevation at the confluence of Big Pine Canyon and the Sisquoc River to small seep and spring side patches at elevations of up to 6200 ft (1890 m). The character of these riparian areas differs depending upon elevation and characteristics of the
moisture source. Three Holland (1986) types of riparian vegetation occur within the RNA. However, because of their limited and sometimes overlapping extent, these are difficult to map effectively at the scale used in this report. Hence, all are mapped under the broad heading above. These include Montane Riparian Scrub (63500), White Alder Riparian Forest (61510), and Central Coast Live Oak Riparian Forest (61220).

The best developed of these three Holland types is the White Alder Riparian Forest. It is extensive along the flowing stretches of the Sisquoc River and Big Pine Canyon, and also dominates at several springs in the vicinity of Upper Bear Camp. Frequently, the white alders in this association are large (up to 32 inches or 81 cm dbh and 100 ft or 31

m tall) and at best development create an arching canopy over narrow rocky streambeds (photo 19). California bay and bigleaf maple often associate with the white alders, and incense-cedar occurs as clumps or isolated individuals along nearly the entire length of the Sisquoc River within the RNA. The understory is often lush and dominated by *Aralia californica*, *Pteridium aquilinum pubescens*, *Galium aparine*, *Urtica holosericea*, *Artemisia douglasiana*, *Rosa californica*, *Rubus leucodermis*, *Equisetum laevigatum*, *Aquilegia formosa*, *Satureja mimuloides*, *Mimulus cardinalis*, and *M. guttatus* with extensive trailing and climbing vines of *Clematis lingusticifolia*. There are occasional seepy areas within this zone with large patches of *Lilium pardalinum* (photo 20), and other moisture loving species such as *Habenaria leucostachys*, *Stachys albens*, and *Carex nudata*. The low, fairly constant volume of these streams and the long intervals between floods has allowed the dominant trees to become large and relatively old with a degree of structuring to the forest not usually seen along small montane creeks (photo 21). It is difficult to conceive of any better example of white alder dominated riparian forest in the South Coast Ranges.

At the lower elevations along Sisquoc River, particularly in sunny areas with accumulation of recent alluvium, other riparian trees are often present, including Fremont cottonwood (*Populus fremontii*), and willows such as *Salix lasiandra* and *S. goodingii* var. *variabilis*. Near the lowest portion of the Sisquoc in the RNA these species often share dominance with white alder. Additional heliophilic riparian understory species such as *Brickellia californica* and *Datisca glomerata* occur in openings beneath the scattered canopy. This situation is reminiscent of Holland's Southern Cottonwood - Willow Riparian Forest (61330), which probably occurs downstream from the RNA.

At these lower elevations the second of the three major riparian elements becomes apparent. This is the coast live oak riparian forest. Coast live oak forms scattered stands and occasionally more extensive gallery forest surrounding the true riparian white alder zone below about 4200 ft (1280 m). Some of these live oaks are spectacularly large, up to 90 ft (27 m) tall and 3 ft (91 cm) dbh, with straight boles, very unlike typical *Quercus agrifolia* in woodlands along the coast. The understory species of this forest include dominants such as poison oak, *Rhus trilobata*, *Amorpha californica*, and snowberry (*Symphoricarpos mollis*) with subordinate species such as *Eriogonum fasciculatum*, *Eriodictyon trichocalyx*, *Phacelia distans*, *Callinsia heterophylla*, and *Galium nuttallii*. These forests occur on natural levees 5-10 ft (1.5-3 m) above the level of the stream. At higher elevations along the Sisquoc River these levee forests of coast live oak are replaced by analogous vegetation dominated by canyon live oak and/or California bay.

The third major riparian type in the RNA is montane riparian scrub. This occurs along the upper reaches of intermittent creeks in Big Pine Canyon as well as near the head of the Sisquoc River at Upper Bear Camp. This vegetation is dominated by scrubby willows, typically *Salix scouleriana* and *S. lasiolepis*. These large shrubs form an

intermittent cover over a rich hydrophilic herbaceous layer. Herb species include *Horkelia elata*, *Potentilla glandulosa* ssp. *nevadensis*, *Lupinus polyphyllus*, *Mimulus guttatus*, *M. pilosus*, *Juncus mexicanus*, *J. macrophyllus*, *Carex subbracteata*, *C. fracta*, *Poa pratensis*, *Cystopteris fragilis*, *Heleocharis bella*, and *Thalictrum fendleri*.

Although not directly analogous, intermittently moist streamside areas with no willow overstory occur. These are particularly conspicuous on crumbly shale areas at the upper reaches of Big Pine Canyon, often adjacent to Jeffrey pine or mixed coniferous forest. One such area in the west-central portion of section 7 between 5700 and 5800 ft (dubbed "Bear Meadow", because of the abundant bear sign), has a typical mixture of vernally hydrophilic annuals and bulb plants, including: *Navarretia intertexta*, *Gayophytum humile*, *Allium amplectens*, *Allium lacunosum*, *Trifolium cyathiferum*, *T. microcephalum*, *Chorizanthe polygonoides*, *Mimulus pilosus*, *Gnaphalium palustre*, *Lotus purshianus*, *Lupinus luteolus*, and *Danthonia californica* var. *americana*. This flora is a unique mixture of low elevation vernal pool, relatively xerophytic, and montane meadow species. The site conditions for these herbaceous stands resemble vernal pools in that they are relatively flat or gently sloping topography with lie along vernally most drainageways or swales. The soil is derived from very fine-grained shale with an relatively high clay content (high moisture holding capacity).

Shale Barrens (no Holland equivalent)
This vegetation type is characteristic of the high elevation shale outcrops in the upper drainages of Big Pine Canyon. Several of these outcrops occur between 5700 and 6500 ft (1737-1981 m). None is larger than about 10 acres (4 ha), and they are separated by mixed coniferous forest, Jeffrey pine forest, montane chaparral, or sandstone outcrops. The parent material is highly fractured dark gray shale, which has little or no true soil component. The small angular fragments of shale range from pea size on the slopes to fine silt in hollows. Often there is a scattering of larger rocks on the surface (photo 22). Vegetative cover is variable ranging from less than 1 percent to about 40 percent. The density-determining conditions are probably substrate moisture, aspect, and depth.

The harsh substrate supports a unique assemblage of plants, several of which occur nowhere else in the RNA (photo 23). These include *Psoralea californica*, *Lomatium dasycarpum*, *Frasera neglecta*, *Allium monticola* var. *keckii*, *Allium burlewii*, *Phacelia imbricata* ssp. *patula*, *Phlox diffusa*, *Eriogonum wrightii* ssp. *subscaposum*, *Fritillaria pinetorum*, *Zauschneria californica* ssp. *latifolia*, *Chrysothamnus nausiosus*, *Astragalus lentiginosus* var. *idriensis*, *Crepis occidentalis* var. *pumila*, *Calochortus invenustus*, *Asclepias californica*, *Madia elegans*, *Mimulus johnstonii*, *Leptodactylon pungens* ssp. *pulchriflorum*, *Eriogonum nudum*, *Sitanion hystrix*, *Chaenactis santolinoides*, and *Eriophyllum confertiflorum*. Although vegetation cover is typically limited to a very sparse cover of herbaceous species, in more sheltered areas with higher soil moisture dense aggregations of *Madia elegans*, *Eriophyllum confertiflorum* and other species may put on showy displays (photo 24).

The drainageways in these shale barrens may have a trickle of water or at least remain moist into early summer. These areas contain such species as *Lupinus luteolus*, *Allium amplectens*, *Navarretia intertexta*, and other species mentioned for these vernally moist habitat in the montane riparian discussion.

Valley and Foothill Grassland (42000):
Open grass- and herb-dominated vegetation occurs at a small glade at Upper Bear Camp (see photo 10), in several small openings in alluvium along the Sisquoc River, and at the site called "Bear Meadow" along the upper reaches of Big Pine Canyon. Each of these sites has a different assemblage of plants, but all have physical and compositional similarities.

The Upper Bear Camp glade is dominated by *Muhlenbergia rigens* with *Artemisia dracunculus*, *Linanthus androsaceus*, *Calochortus venustus*, *Arabis glabra*, *Agoseris retrorsa*, and *Elymus glaucus*. Other moisture-loving plants such as *Equisetum arvense*, *Muhlenbergia richardsonis*, *Juncus mexicanus*, and *Carex subbracteata* are present near the intermittent drainageway at the edge of the glade.

Further downstream along the Sisquoc River, in small openings on alluvial benches bordered by chaparral, canyon live oak, and coast live oak forest are other herbaceous and grass-dominated sites (too small to indicate on vegetation map). These sites have such species as *Bromus diandrus*, *B. rubrum*, *Linanthus androsaceus* ssp. *micranthus*, *L. a*. ssp. *luteus*, *Camissonia campestris*, *Chorizanthe thurberi*, *Clarkia purpurea* ssp. *quadrivunera*, *Clarkia unguiculata*, *Cryptantha clevelandii*, *Eriogonum gracile* var. *polygonoides*, *Lupinus bicolor*, *Allophyllum gilioides*, *Madia gracilis*, and *Penstemon centranthifolius*.

A different type of grassland dominated by annual grasses and herbs occurs in small patches at the upper elevations adjacent to the riparian scrub in "Bear Meadow." *Hordeum leporinum*, *Bromus tectorum*, *Vulpia megalura*, *Vulpia reflexa*, *Elymus caput-medusae*, *Caucalis microcarpa*, *Lotus purshianus*, *Madia minima*, *Linanthus ciliatus*, and *Trifolium microcephalum* are the principal members of this association.

FAUNA

Appendix 2 lists all species of vertebrates known form the BPMRNA. This includes some 80 species noted in the four days of my stay in June 1989 as well as 57 additional species noted during previous survey work by Janet Hamber and associates at the Santa Barbara Museum of Natural History. The rare species and species of special concern were previously mentioned.

A bird census was conducted in the mixed coniferous forest at Upper Bear Camp on the morning of June 12, 1989. This study was begun at 7:43 A.M. and lasted 20 minutes. It involved tallying all individuals heard or seen in a strip approximately 700 by 100 m

(7 ha). Fifty-four individuals of 21 species were tallied. Table 10 displays the totals for the census. Some species not detected from this survey were also common in the mixed coniferous forests of the upper slopes. These included pygmy nuthatch, northern flicker, Cassin's finch, and band-tailed pigeon.

In general, the faunal relationships of the upper elevations of the study area have more in common with the low elevation chaparral and oak woodland formations than they do with the montane coniferous forest. Species typical of southern California chaparral, such as wrentit, blue-gray gnatcatcher, plain titmouse, rufous-sided towhee, black-chinned sparrow, and others, are common and conspicuous up to the crest of the mountains at elevations of more than 6500 ft (1981 m). This trend is true for mammals as well, with no strictly montane species such as montane shrew, lodgepole chipmunk, golden-mantled ground squirrel or other species known from certain other montane areas of Southern California.

Table 10: Results of a 20 minute census for birds conducted on a 700 x 100 m strip of mixed coniferous forest at Upper Bear Camp, Big Pine Mountain RNA.

Species	density (per ha)
Brown creeper	1.00
Dark-eyed junco	0.71
Western wood pewee	0.71
Steller's jay	0.71
Mountain chickadee	0.57
Red-breasted nuthatch	0.43
White-headed woodpecker	0.43
Warbling vireo	0.43
Western tanager	0.43
Purple finch	0.29
American robin	0.29
Western flycatcher	0.29
Rufous-sided towhee	0.29
Black-headed grosbeak	0.14
Anna’s hummingbird	0.14
Olive-sided flycatcher	0.14
Acorn woodpecker	0.14
Orange-crowned warbler	0.14
White-breasted nuthatch	0.14
House wren	0.14
Ash-throated flycatcher	0.14
Total	7.70

GEOLOGY

The high San Rafael Mountains are composed of a thick assemblage of sandstone and some interbeded clay shale and conglomerate, of Cretaceous and Eocene ages. The sedimentary sequence witch dominates the BPMRNA is thousands of feet thick. The San Rafael Mountains were elevated somewhat like a wedge, mainly between two thrust faults that dip under it from each side and the thick sedimentary sequence of this uplifted block is severely folded and faulted. The Sur-Nacimento and the Big Pine faults (sensu Norris 1976) intersect at oblique angles approximately 2 miles (3.2 km) east of the RNA (Jennings et al. 1977). The majority of the RNA is underlain by Upper Cretaceous rocks, principally sandstone, with the notable shale outcrops underlaying the shale barrens of upper Big Pine Canyon. The summit of Big Pine Mountain and the eastern third of the RNA is underlain by Eocene sandstone with minor shale and conglomerates. This Ecocene sandstone appears locally less deformed and uplifted with fewer scarps and large outcrops than the Upper Cretaceous rocks of the Big Pine Canyon area.

SOILS

The soils map of the area (USDA Forest Service 1977) classifies the majority of the area as one mapping unit. It is known as the Livermore - Agua Dulce - Hambright Families Association, 30-80 percent slopes. The three components of the mapping unit make up 40, 20 and 20 percent, respectively, of the mapping unit. Inclusions of the following soil families make up an additional 20 percent of the mapping unit: Rincon, Inks, Lopez, Lodo, and Chular. All three of the principal families in this unit occupy similar landscape positions and slope steepness. Following is a brief description of the three families:

1. The Livermore family is derived primarily from sandstone and has a surface layer of from 0-3 inches (0-8 cm) which is brown gravelly sandy clay loam and in neutral, a subsoil from 3-17 inches (8-43 cm) deep which is yellowish brown very gravelly sandy clay loam about 50% pebbles and 3% cobbles with 7.5 pH; and a substratum from 17-60 inches (43-152 cm) which is yellowish brown extremely gravelly sandy clay loam 60% pebbles and 2% cobbles and a pH of 7.5.

2. The Agua Dulce family has a surface layer 0 to 38 inches (0 to 97 cm) deep that is light brownish gray gravelly loam with 15 percent pebbles and 5 percent cobbles and a pH of 7.4; a subsoil from 38 to 65 inches (97 to 165 cm) that is light yellowish brown very cobbly clay loam 35 percent pebbles and 20 percent cobbles; and a substratum reached at 65 inches (165 cm) that is fractured hard shale.

3. The Hambright family is the shallowest of the three main soils with a surface layer 0-11 inches (0-28 cm) that is grayish brown extremely cobbly loam, 30% pebbles and 40% cobbles with a pH of 6.8. The Hambright family has no subsoil and the substratum is reached at 11 inches (28 cm) and is composed of fractured hard shale.

The other soil mapping unit is the Millsholm - Exchequer -Stonyford Families Association, 30-75 percent slopes. This unit is characteristic of the extremely steep areas of the lower Big Pine Canyon including the cliff faces. It is composed of 35 percent Millsholm, 20 percent Exchequer and 20 percent Stonyford components. All three of these soils are shallow with Millsholm reaching hard fractured siltstone in 14 inches (36 cm), and the other two families reaching hard sandstone in 12 inches (30 cm). The Stonyford is the most acidic with the surface layer averaging pH 6.0. The pH of surface layers of the other family components are: Exchequer, 6.5; and Millsholm 7.1.

AQUATIC VALUES

Although low in volume, the Sisquoc River and Big Pine Canyon both contain numerous pools and short flowing stretches which contain permanent water (photo 25). The intermittent stream courses, springs and seeps in the RNA support a variety of organisms from large, apparently native populations of rainbow trout to a number of aquatic insects. Water ouzels were seen associated with waterfalls on Big Pine Canyon and the upper Sisquoc and may represent a small isolated breeding population (Janet Hamber, SBMNH, pers. Comm.. 1991).

CULTURAL VALUES

The Sisquoc River drainage was the former home of the Interior Chumash peoples (the Cuyama Region of Grant 1978a). Several village sites are known from the Sisquoc downstream from the RNA as are numerous rock painting sites. The Chumash of the Cuyama Region apparently acquired the rock painting tradition from the Yokuts and developed it to its highest point (some well-known examples are at Painted Rock on the Carrizo Plain and Painted Cave near Santa Barbara). The rock paintings of the Chumash are the most interesting and spectacular in the United States (Grant 1978b). The extraordinarily fanciful character of many of the paintings suggests that they were painted by persons under the influence of the powerful hallucinogen toloache (*Datura* sp.) (Grant 1978a).

The locality of Mission Pines (9 trail miles, 14.5 km, west of the junction of the Mission Pines Trail and the Big Pine-Buckhorn Rd.) has been said to be the place where Chumash cut the timbers for the Santa Barbara Mission (Smith 1976).

IMPACTS AND POSSIBLE CONFLICTS

The isolated wilderness location of the RNA precludes most human impacts and conflicts. Recreational use of the Big Pine-Buckhorn Road, the Alamar Trail, and the Mission Pines Trail is relatively light. Based on entries in the registers atop West Big Pine and Big Pine Mountain, most visitors to the area come in the winter and spring.

Mountain bikers are the most common visitors to the summit area, followed by Sierra Club hikers and researchers on condors and other vertebrates. Only one entry by a hunting party was noted. Based on the scarcity of litter and the level of trail wear, recreational impact is light even at established trails and campsites. The two campsites at Upper Bear Camp had been lightly used within the past year before the field work with the upper site near the springs receiving most of the use. The campground known as Big Pine Camp had clearly not been used for several years (despite the 4-5 improved sites concrete fireplaces, and covered spring), perhaps as a result of the lack of water at the spring. The improvements at the Upper Bear and Big Pine campsites were made mostly in the late 1930's (dates on cement fireplaces, etc.).

The road 9N11 has well-controlled access, being gated in several places on either end. It is lightly used by Forest Service personnel, and is otherwise accessible only to researchers and others on official business. The road is a narrow one-lane dirt track with little erosion. No logging or other impacts are associated with the road in the RNA. The area has a rain gage about halfway between the junction of Mission Pines trail and the Big Pine-Buckhorn Rd. and West Big Pine lookout site. This is the only other structure seen in the RNA.

MANAGEMENT CONCERNS

The area is relatively free of management problems. Aside from the one large fire resulting in the ca. 50 year old stand of Coulter pine, there is no evidence of more recent widespread fire. Evidence of a small recent fire near the Bog Pine Camp was noted; however this apparently did not spread into the crowns of trees or cover large areas of brush. The relatively open nature of the majority of the mixed coniferous forest suggests that it is well-protected from damaging crown fire. Although this is less true for the alluvial flat stand at Upper Bear Camp.

BOUNDARY CHANGES

The estimated size of the proposed RNA in the Los Padres National Forest Land and Resource Management Plan (USFS 1989) is 1000 acres (405 ha). Clearly, the boundaries defined in this report include a substantially larger area, although the boundaries drawn by Mark Borchert, Los Padres National Forest Ecologist (1989) include an area larger than is suggested in this report. Map 5 shows the proposed boundary (according to Borchert) and the current boundary advocated in this report. No map is available of the 1000-acre proposal mentioned in the Forest Land and Resource Management Plan. According to Borchert, his boundary was based on aerial photographs and was not field checked. In a letter to the RNA committee, Borchert advised that the contractor for the ecological survey make his own recommendations for boundaries based on field evidence of the extent of the target and associated vegetation. The boundaries proposed in this report are drawn with the intent of including the largest and most diverse stands of mixed coniferous forest vegetation and also bigcone

Douglas-fir/canyon live oak and riparian vegetation in the lower canyons, both of target element value.

Both the main Big Pine Mountain and the alluvial flat stands of mixed coniferous forest were excluded from the original boundaries (map 5). This may have been done to exclude the Big Pine-Buckhorn Road. However, as already discussed, the impacts associated with this road are minimal and will not appreciably detract from the integrity of the area. The values of the main stand of mixed coniferous forest in the vicinity of this road in my opinion far outweigh the detriments of having the road within the RNA boundaries. If necessary, to satisfy RNA regulations, a corridor excluding the road from the boundaries, could be devised.

RECOMMENDATIONS

I strongly recommend the establishment of the Big Pine Mountain RNA. There is no better site for the target vegetation in the South Coast Range Province, and the number of additional attributes including the California condors, other vertebrates, rare plants, and biogeographic significance strengthen the area's value.

LITERATURE CITED

Barbour, M.; Pavlik, B.; Drysdale, F.; Lindstrom, S. 1991. California vegetation: diversity and change. Fremontia19:3-12.

Borchert, M. 1985. Serotony and cone-habit variation inpopulations of Pinus coulteri (Pinaceae) in the Southern Coast Ranges of California. Madrono 32:29-48.

Borchert, M; Hibberd, M. 1984. Gradient analysis of a north slope montane forest in the western Transverse Ranges of Southern California. Madrono 31:129-139.

Eyre, F. H., ed. 1980. Forest cover types of the United States and Canada. Society of American Foresters, Washington D.C.

Grant, C. 1978a. Chumash. In: Heizer, R. F., ed. Handbookof North American Indians Volume 8, California. Washington, DC: Smithsonian Institution.

Grant, C. 1978b. Interior Chumash. In: Heizer, R. F., ed. Handbook of North American Indians Volume 8, California.Washington, DC: Smithsonian Institution.

Griffin, J.; Critchfield, W. 1976. The distribution of forest trees in California. USDA Forest Service Research Paper PSW-82.

Holland, R. 1986. Preliminary descriptions of the terrestrial natural communities of California. Unpublished mimeograph available from California Department of Fish and Game, Sacramento.

Jennings, C. W.; Strangd, R. G.; Rogers, T. H. 1977. Geologic Map of California. Sacramento: California Division of Mines and Geology.

Keeler-Wolf, T. 1986a. An ecological survey of the proposed Doll Basin Research Natural Area, Mendocino National Forest, California. Unpublished report on file at the Pacific Southwest Research Station, Berkeley, California.

Keeler-Wolf, T. 1986b. Ecological survey of the proposed Hall Canyon Research Natural Area, San Bernadino National Forest, Riverside County, California. Unpublished report on file at the Pacific Southwest Research Station, Berkeley, California.

Kuchler, A.W. 1966. Potential natural vegetation. U. S.Dept. Interior, Geol. Survey 1969.

McDonald, P. M; Littrell, E. L. 1976. The bigcone Douglas-fir-Canyon live oak community in southern California. Madrono 23: 310-320.

Munz, P. A. 1974. A flora of southern California. Berkeley; Los Angeles: University of California Press.

Norris, R. F; Webb, R. 1976. Geology of California. NewYork: John Wiley and Sons.

Palmer, R. 1981. Ecological survey of the vegetation of the Sugar Pine Point area, Tahoe National Forest, California. Unpublished report on file at the Pacific Southwest Research Station, Berkeley.

Rantz, S. E. 1972. Mean annual precipitation in the California region. U.S.G.S. Map, Menlo Park, California.

Smith, C. 1976. Flora of the Santa Barbara region. Santa Barbara Museum of Natural History.

Smith, J. P. and K. Berg. 1988. Inventory of rare and endangered vascular plants of California (fourth edition). Sacramento: California Native Plant Society.

Steinhart, P. 1990. California's wild heritage: threatened and endangered animals in the Golden State. Sierra Club Books, in cooperation with California Department of Fish and Game and the California Academy of Sciences.

Taylor, D. W.; Randall, D.C. 1978. Ecological survey of the vegetation of the Cub Creek watershed, Lassen National Forest. Unpublished report on file at the Pacific Southwest Research Station, Berkeley.

U.S.D.A. Forest Service. 1977. Draft order three soil survey of the Los Padres National Forest. Drafts on file at Los Padres National Forest Supervisor's and District Ranger's offices, Goleta, California.

U.S.D.A. Forest Service. 1989. Los Padres National Forest Land and Resource Management Plan. Available from Los Padres National Forest, Goleta, California.

APPENDIX 1
VASCULAR PLANTS OF BIG PINE MOUNTAIN CANDIDATE RNA

The following list includes all species identified during the four day period from June 9-12, 1989. Also included are species mentioned for the area by Smith (1976). Taxonomy follows Munz (1968, 1974). This list includes approximately 286 taxa. Habitats following the plant names are abbreviated in the following way:

Mcf…….mixed coniferous forest
Sb.....shale barrens
jp.....Jeffrey pine forest
chap.....northern mixed chaparral
mc.....montane chaparral
Q. agrifolia wdl.....coast live oak riparian phase
cp.....Coulter pine
co.....canyon live oak

Abies concolor; common mcf, 5000-6800 ft
Acer macrophyllum; occasional moist areas along Sisquoc and N-facing ravines on Big Pine Mountain
Adenostoma fasciculatum; lower elev. chap, lower Sisquoc and Big Pine Canyon drainages
Agoseris grandiflora: cited for Big Pine Mountain by Smith (1976)
Agoseris retrorsa; uncommon but widespread mcf, chap., jp
Agropyron parishii var. *laeve*; rhizomatous, uncommon in openings, edges of shale barrens, jp, mcf, co upper elevations
Allium amplectens; abundant in "Bear Meadow" about 5800 ft upper reaches of Big Pine creek also in cracks in sandstone adjacent to creek
Allium burlewii; uncommon on shale about 6500 ft on W side of Big Pine Mountain
Allium campanulatum; occasional dry banks cp-chap.
Allium lacunosum; mostly a serpentine endemic, but on sterile shale bottom land in hollows and low gradient gullies in jp. has mostly purple anthers (not yellow), not reported above 3000 ft by Munz, but above 6000 ft here
Allium monticola var. *keckii*; characteristic of shale barrens W Big Pine, single leaved, purple flowers, a rare plant
Allophyllum gilioides; scattered in openings from low to high elevations
Allophyllum intrigifolium; occasional at summit of Big Pine Mountain 6800 ft
Alnus rhombifolia; dominant in riparian along Sisquoc, Big Pine Canyon, springs at Upper Bear Camp, etc.
Amelanchier pallida; occasional, upper elevations sheltered rocky mcf
Amorpha californica; common upper elevations in co, edges mcf, mc, etc, food plant of California dogface butterfly
Angelica tomentosa; leaves generally narrow and glabrous, up to 6800 ft and down to 5100 ft mostly in mcf semi-shade

Apocynum canabinum var. *glaberrimum*; uncommon along moist parts of Big Pine Canyon mid-elevations
Aquilegia formosa; riparian, Sisquoc River
Arabis glabra; glade, Upper Bear Camp
Arabis repanda; common in understory of mcf, a montane disjunct
Arabis perennans; occas. chap. throughout up to 6200 ft.
Aralia californica; riparian, Sisquoc River, Big Pine Canyon
Arceuthobium abietinum; reported (Smith 1976) on white fir for Big Pine Mountain
Arceuthobium californicum; reported on sugar pine for Big Pine Mountain by Smith (1976)
Arceuthobium campylopodum; on jp, mcf
Arctostaphylos glandulosa; common at mid and upper elevations inchap.
Arctostaphylos glauca; lower chap.
Arctostaphylos parryana; small green leaves, no burl, jp, upper mc, co, shale barrens, a montane disjunct
Arnica discoidea; mcf and bd about 5400-6200 ft
Artemisia douglasiana; moist areas from 3300-6200 ft
Artemisia dracunculus; glade at upper Bear Camp
Asclepias californica; prostrate form on shale ridge around 6400 ft
Astragalus lentiginosus var. *idriensis*; common only on shale barrens
Avena barbata; dwarfed on shale up to 6300 ft
Balsamorhiza deltoidea; jp, co, occasionally
Boisduvalia densiflora; riparian, Big Pine Canyon
Brickellia californica; riparian lower Sisquoc River and Big Pine Canyon
Bromus diandrus; occasional, lower Sisquoc River valley in openings in chap, *Q. agrifolia* woods
Bromus marginatus; fairly common in semi-shade low to high elevations
Bromus rubens; occasional in chap mid elevations
Bromus tectorum; Upper Bear Camp 5100 ft
Calocedrus decurrens; common mcf 4500-6800 ft, some as low as 4000ft along Sisquoc
Calochortus invenustus; fairly common openings at upper elevations, mcf, mc, etc,
Calochortus venustus; common along Sisquoc trail in openings in chap, *Q. agrifolia* wdls. etc.
Calyptridium monandrum; open + disturbed places along trail at upper elevations
Calystegia malacophylla ssp. *pedicelluta*; occasional openings in mc, jp, and co upper elevations
Camissonia bistorta; uncommon dry slopes above "Bear Meadow" S-slopes cp-chap.
Camissonia campestris; low elevations along Sisquoc trail in openings in chap. etc.
Carex fracta; moist meadowy area "Bear Meadow" and Upper Bear Camp
Carex multicaulis; mcf, co mid elves.
Carex nudata; banks of Sisquoc River. near Bear Camp, also along creek in Big Pine canyon
Carex serratodens: cited for Big Pine Mountain by Smith (1976)
Carex subbracteata; moist areas at Upper Bear Camp, near S limits
Castilleja applegatei; occasional as at "Bear Meadow" scablands 6200 ft may be S. limits (from Mt. Pinos)

Castilleja martinii; not listed for Santa Barbara Co. most common at upper elevations but widespread throughout
Castilleja linariaefolia; along Big Pine Canyon up to 5800 ft
Castilleja stenantha; moist bank, "Bear Meadow" 5800 ft
Caucalis microcarpa; "Bear Meadow", up to 5800 ft only listed for 5000 ft
Ceanothus integerrimus; mc, openings mcf, co
Ceanothus leucodermis; mc, co, cp-chap
Ceanothus sp. lower chap S slopes with *Ephedra viridis*
Cercocarpus betuloides; common chap up to crest
Chaenactis sp. jp forest
Chaenactis santolinoides; shale barrens, montane disjunct
Chenopodium sp. 1;. annual occasional in mcf
Chenopodium sp. 2; annual occasional in openings along lower Sisquoc
Chenopodium fremontii: reported for Big Pine Mountain by Smith (1976)
Chorizanthe clevelnadii: cited for Big Pine Mountain by Smith (1976)
Chorizanthe polygonoides; common in shale drainageways at upper elevations
Chorizanthe thurberi; locally abundant in dry flats along Sisquoc River
Chrysothamnus nauseosus; locally common along disturbed areas, Mission Pines trail, edges of blowouts, etc. mostly ssp. *mohavensis*
Cirsium californicum; pale lavender, buff chaparral-cp mid elevations
Clarkia deflexa; occasional Sisquoc River trail, openings
Clarkia purpurea ssp. *quadrivunera*; occasional dry open flats along Sisquoc River
Clarkia rhomboidea; fairly common, openings, semi-shade along summit crest, also in mcf near Upper Bear Camp
Clarkia unguiculata; common along Sisquoc River. trail, openings in chap.
Claytonia perfoliata; occasional in mcf, small plants
Claytonia spathulata; common in mcf
Clematis lingusticifolia; riparian, Sisquoc River.
Collinsia childii; occasional mcf in openings
Collinsia heterophylla; semi-shade of *Q. agrifolia* woods along Sisquoc trail.
Collinsia sp; yellow-greenish flowers, jp upper elevations (may be *C. childii*, cited for Big Pine Mountain by Smith 1976)
Collomia grandiflora; co, upper elves.
Cordylanthus sp.; jp, co, (probably *C. nevinii*, but *C. rigidus* also known from area, fide Smith 1976)
Corethrogyne filaginifolia var. *brevicula*; openings in jp, co, etc. down to low elevations
Crepis occidentalis ssp. *pumila*; uncommon upper elevations, sb, mc, e.g. "Bear Meadow" S limit Ventura Co.
Cryptantha clevelandii; fairly large flowers along Sisquoc River in openings to about 3800 ft (listed only to 2500 ft by Munz 1974)
Cryptantha echinella: collected by Smith (1976) on summit of Big Pine Mountain
Cryptantha intermedia; occasional throughout up to summits
Cryptantha muricata var. *jonesii*: Smith collected it on West Big Pine
Cryptantha simulans: as above

Cuscuta sp.; on *Eriogonum wrightii*, open jp, co, shale barrens, along crest
Cystopteris fragilis; occasional upper elevations moist crevices
Danthonia californica var. *americana*; edges of moist or vernally moist bottomlands in shale and sandstone 5800-6200 ft, not mentioned for this area (San Rafael-Big Pine Mountains).
Datisca glomerata; riparian, lower Sisquoc River.
Delphinium parishii; occasional semi shade, Sisquoc River to summit crest (*D. parishii* ssp. *purpureum* fide Smith 1976 is an endemic to the mountains of Santa Barbara Co.)
Delphinium patens ssp. *montanum*; occasional mcf, may be westernmost limit, a southern California montane species
Dichelostemma pulchella; occasional widespread in openings up to summit Big Pine Mountain
Dryopteris arguta; *Q. agrifolia* woods, lower Sisquoc
Dudleya cymosa ssp. *minor*; orange flowers, on cliffs below W Big Pine
Heleocharis bella; wet seep and bank “Bear Meadows”
Elymus caput-medusae; uncommon "Bear Meadow"
Elymus condensatus; occasional ecotones between jp and chap, mcf and co, 5000-6700 ft
Elymus glaucus; occasional mcf, co, 5000-6300 ft
Ephedra viridis; low elev chap, S slopes of Big Pine Canyon
Epipactis gigantea; uncommon, riparian, Sisquoc River
Equisetum arvense; moist glade, Upper Bear Camp
Equisetum laevigatum; occasional Sisquoc riparian
Eriastrum densifolium ssp. *austromontanus*; openings in jp, co, mcf, upper elevations
Erigeron foliosus; common co, chap, mcf
Eriodictyon trichocalyx; mcf-jp border, Big Pine Mtn. ridge, to chap in lower Sisquoc
Eriogonum fasciculatum; low s-facing chap, Sisquoc R. canyon, occas. in openings up to summits
Eriogonum gracile var. *polygonoides*; occasional along Sisquoc tr. in openings
Eriogonum hirtiflorum; annual, occasional at crest, chap-jp-mcf ecotones, not reported above 6000 ft by Munz, but up to 6800 ft here
Eriogonum nudum; common, jp, co, open mcf
Eriogonum saxatile; rocky openings chaparral, co, rock outcrop
Eriogonum umbellatum ssp. *aridum*; upper elevations on shale and other openings, a montane disjunct
Eriogonum wrightii ssp. *subscaposum*; fairly common in shale and other openings upper elevations, a montane disjunct
Eriophyllum confertiflorum; fairly common from chap to mcf, some herbaceous indivs. at upper elevations are var. *tridactylum*
Erodium cicutarium; occasional glade openings along Sisquoc River.
Erysimum capitatum; jp, co, mcf
Frasera neglecta; shale barrens upper elevations Transverse Range endemic, westernmost occurrence?
Fritillaria pinetorum; on Mission Pines trail, open mc, sb, a montane disjunct
Galium andrewsii; common mid-high elevations co, cp-chap.
Galium angustifolium; occasional low to mid-elev chap. *Q. agrifolia* wdl.

Galium aparine; shaded areas of forest and woodlands throughout
Galium nuttallii; lower Sisquoc valley chaparral
Galium trifidim var. *pacificum*; occasional along Sisquoc River. In shade
Garrya flavescens var. *pallida*; common in chap., cp, and co
Gayophytum diffusum parvifolium; fairly common in openings along Sisquoc River, up to mid and upper elevations
Gayophytum humile; tiny annual in vernally moist shale drainageways at upper elevations, a montane disjunct sp.
Gilia capitata ssp. *abrotanifolia*: reported by Smith (1976) for Big Pine Mountain
Gilia latiflora ssp. *cuyamensis*; flats along Sisquoc River.
Gilia modocensis; fairly common summit crest of Big Pine Mountain in openings in mcf, jp
Gilia splendens; occasional, as at summit of Big Pine Mountain 6800ft
Gnaphalium palustre; vernally moist shale swales upper elevations
Haplopappus arborescens; cited by Smith (1976) for Big Pine Mtn.
Haplopappus cuneatus; rocks upper elves.
Haplopappus squarrosus ssp. *obtusus*: cited for Big Pine Mountain by Smith (1976)
Holodiscus microphyllus; uncommon, cracks in sandstone scablands, jp, above "Bear Meadow" about 6000 ft
Hordeum leporinum; uncommon "Bear Meadow"
Horkelia bolanderi ssp. *parryi*; white flowers, just coming into bloom, common only in moist areas at "Bear Meadow" 5600-5900 ft, a montane disjunct.
Hulsea heterochroma: cited for Big Pine Mountain by Smith (1976)
Juncus kelloggii: collected near summit of rd. at Big Pine Mountain (Smith 1976)
Juncus sphaerocarpus: as above (Smith 1976)
Juncus uncinalis: as above in small depression in Jeffrey pine forest (perhaps shale drainage?)
Juncus macrophyllus; common along moist streambeds upper Bear Camp,"Bear Meadows", etc up to 5900 ft
Juncus mexicanus; upper Bear Camp
Keckiella breviflora; common from rocky gravel of Sisquoc River bed up to outcrops along crest about 6700 ft
Keckiella ternata ssp. *septentrionalis*: cited for Big Pine Mountain by Smith (1976)
Koeleria macrantha: collected at Big Pine Mountain by Smith (1976)
Lathyrys laetiflorus; uncommon up to 6300 ft openings in co, with *Chrysothamnus nauseosus*, etc.
Leptodactylon californicum; lower Sisquoc R. drainage, chap.
Leptodactylon pungens ssp. *pulchriflorum*; common rocky areas around summits, on shale barrens, etc.
Lilium *pardalinum*; riparian seeps, lower Sisquoc River, Big Pine Canyon
Linanthus androsaceus ssp. *luteus*; yellow flowers; flats along lower Sisquoc River.
Linanthus androsaceus ssp. *micranthus*; uncommon along dry openings Sisquoc River. trail
Linanthus androsaceus; white flrd form common around upper Bear Camp.
Linanthus ciliatus; very common at "Bear Meadow" and in openings along other upper elev. tributaries of Big Pine Canyon

Lomatium dasycarpum; common in openings on shale, all indivs. are acaulescent, 6000-6500 ft and are transitional with *L. mohavense*, cited for Big Pine Mountain by Smith (1976)
Lonicera interrupta; occasional, chap. up to crest
Lotus crassifolius; occasional, summit crest, mcf, jp, co
Lotus macranthus ?; 3 lfts. annual along w Big Pine trail not in flr.
Lotus nevadensis; common in shaley areas in jp forest, typically replaced in S. California by *L. davidsonii* which is reported for Big Pine Mtn. by Smoth (1976)
Lotus purshianus; fairly common at "Bear Meadow"
Lotus scoparius; occasional lower chap.
Lupinus bicolor; flats along Sisquoc River. lower elevations
Lupinus elatus; common in mcf, largely endemic to W Transverse Ranges
Lupinus excubitus ssp. *austromontanus*; mc, edge mcf, sb, upper elevations
Lupinus luteolus; common at upper elevations in vernally moist openings, eg., edges of shale barrens in drainageways
Lupinus latifolius var. *parishii*; scattered along upper stream in Big Pine Canyon above 5200 ft, a montane disjunct
Madia elegans ssp. *wheeleri*; common on shale, less so on sandstone, dense aggregations, upper elevations
Madia gracilis; occasional along Sisquoc trail open *Q. agrifolia* woods and flats
Madia minima; sandstone scablands and meadow edge above "BearMeadows"
Mahonia dictyota; common upper chaparral-jp ecotone Big PineMountain
Marah fabaceus var. *agrestis*; occasional upper chap., mcf, and co upper elevations
Melica imperfecta; widespread low to high in chap. and rocks
Mentzelia congesta; collected by Smith (1976) at Big Pine Mountain
Mentzelia montana; open shale and sandstone up to 6700 ft
Microseris gracilis; occasional upper elevations, in openings in mcf, jp
Mimulus cardinalis; riparian Sisquoc, Big Pine Canyon, etc.
Mimulus floribundus; cited for Big Pine Mountain by Smith (1976)
Mimulus guttatus; streamsides and seeps throughout
Mimulus johnstonii; scattered on shale in jp, open co, mcf, a montane Transverse Range species
Mimulus longiflorus; lower rocky S slopes lower Big Pine Canyon
Mimulus pilosus; tiny annual in shale dranageways of upper elevations, larger along moist areas along Sisquoc River near upper Bear Camp
Mimulus suksdorfii; cited by Smith (1976) as possibly at Big Pine Mountain
Monardella lanceolata: collected by Smith (1976) on Big Pine Mountain
Monardella odoratissima ssp. *australis*: cited for Big Pine Mountain by Smith (1976)
Muhlendergia richardsonis; most banks upper Big Pine cr. Also upper Bear Camp Meadow 5100 ft
Muhlendergia rigens; glades, e.g., Upper Bear Camp
Navarretia intertexta; common with *Gayophytum humile* in shale drainageways, upper elevations
Orobanche fasciculata; on *Eriogonum wrightii* at edge of shale barrens about 6200 ft
Osmorhiza brachypoda; fairly common oak woods, Sisquoc Valley, up to around 6300 ft in moist + shady areas

Osmorhiza chilensis; fairly common lower mcf, as near Upper Bear Camp, a montane disjunct
Penstemon bridgesii: cited by Smith (1976) for summit of Big Pine Mountain
Penstemon centranthifolius; occasional chap, co up to crest
Penstemon grinnellii ssp. *scrophularioides*; mc, disturbed trail edge, road edge mcf, a montane disjunct
Penstemon heterophyllus; fairly common low elevations, also on scabland above "Bear Meadow" at around 6000 ft
Penstemon laetus?; summit crest W Big Pine, co.
Penstemon speciosus; uncommon jp, W Big Pine, W. limits here?
Perideridia parishii: shale rivulets about 5700-6200 ft
Phacelia cicutaria var. *hispida*; lower Sisquoc River. semi shade of *Q. agrifolia* woods and chap.
Phacelia curvipes; common blue-purple (occasionally white) flrd. annual of openings in mcf
Phacelia distans; fairly common along Sisquoc R., but up to 6200 ft
Phacelia imbricata; fairly common in dry areas such as shale barrens, openings in mcf, etc. this and the nexta taxon are close to *P. egena*, cited for Big Pine Mountain by Smith (1976)
Phacelia imbricata ssp. *patula*; a montane disjunct, dry shale barrens, open jp
Phlox diffusa; shale barrens open jp, a montane disjunct, not cited by Smith (1976)
Phoradendron bollianum; often abundant on white fir, mcf
Pinus coulteri; common cp-chap, occasional edge mcf
Pinus jeffreyi; common jp, mcf 5100-6800 ft
Pinus lambertiana; common mcf 5000-6800 ft
Pinus monophylla; rare co, upper ridge crest sw corner up to 6300 ft
Pityrogramma triangularis; moist rock crevices mid and upper elevations.
Poa pratensis; Upper Bear Camp and "Bear Meadow"
Poa scabrella; common throughout in openings and semi-shaded areas
Polemonium micranthum; occasional as on summit plateau of Big Pine Mountain 6800 ft
Polystichum munitum; co, bay woods lower Big Pine Cyn.
Populus fremontii; occas. lower Sisquoc River
Potentilla glandulosa ssp. *nevadensis*; moist areas upper elevations a montane disjunct
Prunus emarginata; local patches in mc upper elevations
Prunus ilicifolia; lower chap. lower Sisquoc and Big Pine Canyon drainages
Prunus virginiana var. *demissa*; occasional upper elevations co, mc, a montane disjunct
Pseudotsuga macrocarpa; common inner canyons of Big Pine Canyon and N slope Big Pine Mountain up to 5800 ft
Psoralea californica; restricted to shale barrens on W Big Pine Mountain 6200-6400 ft, most have 6 - 7 leaflets
Psoralea macrostachya; riparian lower Sisquoc River
Pteridium aquilinum var. *pubescens*; moist areas, riparian, mcf, e.g. Upper Bear Camp
Pyrola picta f. *aphylla*; mcf uncommon
Quercus agrifolia; common lower Sisquoc River canyon *Q. agrifolia* wdl., up to 5500 ft; shrubby forms (perhaps hybrids with *Q. dumosa*) in cp-chap.
Quercus chrysolepis; common, co, edge mcf, cp-chap
Quercus dumosa; common chap, up to crest around 6300 ft

Quercus wislizenii var. *fructescens*; mc, up to 6300 ft
Rhamnus californica ssp. *cuspidata*?; fairly common to above 6000 ft flowers attractive to bees, leaves are mostly pubescent
Rhamnus crocea; lower Sisquoc River canyon
Rhus trilobata; occasional in thickets in Sisquoc River drainage
Ribes roezlii; co, mcf, upper elevations
Rosa californica; common Sisquoc River riparian, has bristly galls on leaves
Rubus leucodermis var. *bernardinus*; rill in mcf around 6000 ft also moist mcf near upper Bear Camp around 5300 ft, largely a Transverse Range taxon.
Salix goodingii var. *variabilis*; fairly common along Sisquoc and lower Big Pine Canyon
Salix lasiandra; often tree-sized willow low elevations along Sisquoc
Salix lasiolepis; Sisquoc riparian, up to 6200 ft at "Bear Meadow"
Salix scouleriana; most common willow of upper elev. streams and moist places up to 6300 ft
Salvia columbariae: cited for Big Pine Mountain (Smith 1976)
Salvia leucophylla; lower chap. Big Pine Canyon
Sambucus caerulea; occasional mcf, co, mc
Sambucus mexicanus; occasional, up to 6500 ft in openings in mcf, co
Sanicular graveolens; jp, mcf, occas. a montane disjunct
Sanicular tuberose; c, co
Sarcodes sanguinea: reported for Big Pine Mountain mcf (Smith 1976), a montane disjunct
Satureja mimuloides; orange-red flowers, riparian along Sisquoc River and lower Big Pine Canyon, nice odor
Sidalcea hickmanii ssp. parishii: noted for Big Pine Mountain chaparral by Smith (1976) and Smith and Berg (1988).
Silene lemmonii; fairly common mcf, a montane disjunct
Silene verecunda ssp. *platyota*: reported from mcf at Big Pine Mountain similar to above (Smith 1976)
Sisymbrium sp.?; openings lower Sisquoc
Sitanion hystrix; jp, rocky areas
Solanum umbelliferum var. *incanum*; occasional mountain chap., up to 6500 ft listed only to 4500 ft (known as S. californicum in Smith1976)
Solidago californica; *Q. agrifolia* wdl. To jp at summits, scattered
Stachys albens; fairly common along creek in Big Pine Canyon semi-shade, large leaves
Stachys bullata; lower Big Pine Canyon
Stephanomeria cichoriacea; occasional among rocks upper elevations co, mc
Symphoricarpos mollis; shade of *Q . agrifolia* lower elevations
Symphoricarpos parishii; common in openings in mcf and chap along crest, a montane disjunct
Tauschia hartwegii?; openings in mcf, jp, larger glaucous leaves than *T. parishii*, not reported by Munz above 5000 ft but up to 6200 ft here
Tauschia parishii; common in open jp and mcf above 6000 ft
Thalictrum fendleri; occasional, upper Big Pine Creek streamside, a montane sp.
Thalictrum polycarpum; semi-shade lower Sisquoc River valley, lower Big Pine Canyon

Thermopsis macrophylla var. *velutina*; common along crest of Big Pine Mountain edge mcf, mc. more scattered down to 6200 ft *T. m.* var. *agnina* is a rare plant endemic to Santa Barbara Co. collected fromthe Big Pine Mountain quadrangle (Smith and Berg 1988)
Toxicodendron diversilobum; lower Sisquoc valley, *Q. agrifolia* woodlands, chap., etc.
Trifolium cyathiferum; common only at "Bear Meadow", known in S. Calonly from Mt. Pinos?
Trifolium microcephalum; common at "Bear Meadow" and associated vernally moist areas
Umbellularia californica; scattered Sisquoc riparian up to 6500 ft in chap
Urtica holosericea; riparian, upper Bear Camp. Sisquoc R.
Verbena lasiostachys; disturbed areas, road sides
Vicia americana; depauperate forms fairly common in openings on shale in mcf, jp
Viola purpurea ssp. *xerophyta*; jp, openings in mcf, a montane disjunct
Vulpia megalura; border of "Bear Meadow" 5800 ft
Vulpia reflexa; less common, with above
Yucca whipplei; common chap. to crests
Zauschneria californica; occasional rocky areas chap., lower elevations
Zauschneria californica ssp. *latifolia*; higher elevations mcf, jp, sb, a montane taxon
Zigadenus fremontii; occasional chap. up to crest at 6000 ft (not reported above 3500 ft)

APPENDIX 2: VERTEBRATES KNOWN FORM THE BIG PINE MOUNTAIN CANDIDATE RNA

This list includes all species deteced during the ecological survey June 9-13, 1989 and some additional species (indicated by *) based on information provided by Janet Hamber, Santa Barbara Museum of Natural History. The total number of species is 137. Abbreviations for habitats are the same as in appendix 1.

Fish:
Rainbow Trout (*Salmo gairdneri*): in several flowing stretches of lower Sisquoc River.

Reptiles and Amphibians:
Pacific Treefrog (*Hyla regilla*): tadpoles seen in pool at "Bear Meadows" 5800 ft
American Toad (*Bufo boreas*):*
Western Fence Lizard (*Sceloporus occidentalis*): common throughout up to summit of Big Pine Mountain
Sagebrush Lizard (*Sceloporus graciosus*): common at upper elevationsin open jp and chap.
Side-blotched Lizard (*Uta stansburryana*)*
Southern Alligator Lizard (*Gerrhonotus multicarinatus*): seen twice at lower and mid elevations Upper Bear Camp and Big Pine Canyon
Western Skink (*Eumeces skiltonianus*)*
Western Whiptail (*Cnemidophorus tigris*): seen in chaparral, lower Sisquoc
California Legless Lizard (*Anniella pulchra*)*
Ringneck Snake (*Diadolphis punctatus*)*
Gopher Snake (*Pituophus melanoleucus*): seen in Big Pine Canyon near creek
California Mountain Kingsnake (*Lampropeltis zonata*): a 28 inch individual seen along dry creek bed of lower Big Pine Canyon
Western Aquatic Gartersnake (*Thamnophis couchii*): seen along Sisquoc River.
Western Rattlesnake (*Crotalus viridis*)*

Birds:
Mountain Quail (*Oreortyx pictus*): faily common, form sisquoc to crest
Sharp-shinned Hawk (*Accipiter striatus*)*
Cooper's Hawk (*Accipiter cooperi*): seen over mcf twice in 4 days
Red-tailed Hawk (*Buteo jamaicensis*): occasional over mcf and jp
Golden Eagle (*Aquila chrysaetos*): sighted several times over mcf Big Pine Mtn also perched in tall sugar pine.
Prairie Falcon (*Falco mexicanus*): *
Peregrine Falcon (*Falco peregrinus*): *
Turkey Vulture (*Cathartes aura*) occasional overhead throughout
California Condor (*Gymnogyps californianus*): previous to 1986 a regular breeder and year round resident of the area (see text)

American Kestrel (*Falco sparverius*): possible nesting pain in mcf snag near West Big Pine
Mourning Dove (*Zenaida macroura*): uncommon lower Sisquoc drainage
Band-tailed Pigeon (*Columba fasciata*): flocks in mcf and other upper elevation habitats
Greater Roadrunner (*Geococcyx californianus*):*
Western Screech Owl (*Otus kennicottii*): heard upper Bear Camp June11
Great Horned Owl (*Bubo virginianus*): heard at Upper Bear Camp June11, Big Pine Mountain June 12
Spotted Owl (*Strix occidentalis*): heard Upper Bear Camp June 11, noted as nesting in area by Hamber
Northern Saw-whet Owl (*Aegolius acadicus*):* Upper Bear Camp
Flammulated Owl (*Otus flammeolus*): * Upper Bear Camp
Northern Pygmy Owl (*Glaucidium gnoma*): *
Common Poorwill (*Phalaenoptilus nuttallii*): heard calling from Upper Bear Camp
White-throated Swift (*Aeronautes saxitilis*): common over cliffs, upper elevations
Vaux Swift (*Chaetura vauxi*): *
Black-chinned Humingbird (*Archilochus alexandri*): *
Costa's Hummingbird (*Calypte costae*): *
Anna's Hummingbird (*Calypte anna*): fairly common lowest to highest elevations
Rufous Hummingbird (*Selasphorus rufus*):*
Allen's Hummingbird (*Selasphorus sasin*): *
Acorn Woodpecker (*Melanerpes formicivorus*): occasional mcf, co
Northern Flicker (*Colaptes auratus*): occasional mcf, jp
Red-breasted Sapsucker (*Sphyrapicus ruber*): breeding in mcf at Upper Bear Camp
Hairy Woodpecker (*Picoides villosus*): occasional mcf, jp
Downy Woodpecker (*Picoides pubescens*): uncommon riparian, lower Sisquoc
White-headed Woodpecker (*Picoides albolarvatus*): common mcf and jp
Nuttall's Woodpecker (*Picoides nuttallii*):*
Ash-throated Flycatcher (*Myiarchus cinerascens*): fairly common from low to high elevations in chap and other open habitats
Western Wood Pewee (*Contopus sordidulus*): common mcf
Olive-sided Flycatcher (*Contopus borealis*): uncommon mcf
Western Flycatcher (*Empidonax difficilis*): occasional lower canyons and Upper Bear Camp
Dusky Flycatcher (*Empidonax oberholseri*) locally common in mc upper slopes Big Pine Mountain
Black Pheobe (*Sayornis nigricans*): uncommon over pools in creek, Big Pine Canyon
Violet-green Swallow (*Tachycineta thalassina*): m common over mcf and mc, and other habitats throughout
Cliff Swallow (*Hirundo pyrrhonota*):*
Purple Martin (*Progne subis*): * likely breeder in mcf on Big Pine Mountain
Common Raven (*Corvus corax*): occasional overhead throughout
American Crow (*Corvus brachyrhynchos*): *
Steller's Jay (*Cyanocitta stelleri*): common mcf, bdf

Scrub Jay (*Aphelocoma caerulescens*): common in chaparral throughout
Clark's Nutcracker (*Nucifraga columbiana*):* mcf
Mountain Chickadee (*Parus gambeli*) common mcf
Plain Titmouse (*Parus inornatus*): fairly common up to crest in co and jp
Bushtit (*Psaltriparus minimus*): occasional in flocks low to high elevations
American Dipper or Water Ouzel (*Cinclus mexicanus*): at waterfalls in Big Pine Canyon and Sisquoc River.
White-breasted Nuthatch (*Sitta carolinensis*): occasional mcf
Red-breasted Nuthatch (*Sitta canadensis*): fairly common mcf
Pygmy Nuthatch (*Sitta pygmaea*): common in flocks in upper mcf
Brown Creeper (*Certhia americana*): common mcf
House Wren (*Troglodytes aedon*): occasional at upper elevations in mc, etc
Winter Wren (*Trogolodytes troglodytes*):* at Bear Camp.
Bewick's Wren (*Thryomanes bewickii*): fairly common in mc, chap. and cp
Rock Wren (*Salpinctes obsoletus*): occasional escarpments near West Big Pine
Canyon Wren (*Catherpes mexicanus*): occasional escarpments near W. Big Pine and Big Pine Canyon
Wrentit (*Chamaea fasciata*): fairly common in chap and mc throughout
California Thrasher (*Toxistoma redivivum*): occasional through in chap and mc
American Robin (*Turdus migratorius*): fairly common mcf
Varied Thrush (*Ixorius naevius*):*
Townsend's Solitaire (*Myadestes townsendi*): * mcf
Hermit Thrush (*Cathartus guttatus*):*
Western Bluebird (*Sialia mexicana*): uncommon jp and mcf
Mountain Bluebird (*Sialia currucoides*): *
Blue-gray Gnatcatcher (*Polioptila caerulea*): common in chap and mc up to crest
Golden-crowned Kinglet (*Regulus satrapa*):*
Cedar Waxwing (*Bombycilla cedrorum*):*
Phainopepla (*Phainopepla nitans*):*
Hutton's Vireo (*Vireo huttoni*): occasional co, cp-chap
Solitary Vireo (*Vireo solitarius*): mcf at Upper Bear Camp, co
Warbling Vireo (Vireo gilvus): fairly common along Sisquoc River riparian and in mcf at Upper Bear Camp
Nashville Warbler (*Vermivora ruficapilla*)*
Yellow Warbler (*Dendroica petechia*): several seen in riparian, Lower Sisquoc, presumed breeding
Yellow-rumped (Audubon's) Warbler (*Dendroica coronata*): occasional mcf, jp, probably breeds
Black-throated Gray Warbler (*Dendroica nigrescens*): fairly common co, cp, mcf
MacGillivray's Warbler (*Oporornis tolmei*):*
Orange-crowned Warbler (*Vermivora celata*): fairly common mc, edge mcf mid to upper elevations
Wilson's Warbler (*Wilsonia pusilla*): occasional along riparian, Sisquoc River. e.g. Lower Bear Camp

Brown-headed Cowbird (*Molothrus ater*):*
Western Tanager (*Piranga ludoviciana*): fairly common mcf, co, cp-chap, etc
Black-chinned Sparrow (*Spizella atrogularis*): common chap and mc also jp
Rufous-crowned Sparrow (*Aimophila ruficeps*):*
Chipping Sparrow (*Spizella passerina*):*
Fox Sparrow (*Passerella iliaca*): common only in mc, particularly bitter cherry-choke cherry phase
Dark-eyed (Oregon) Junco (*Junco hyemalis*): common mcf
Rufous-sided Towhee (*Pipilo erythrophthalmus*): common chap, mc, co throughout
California (Brown) Towhee (*Pipilo crissalis*): occasional chap, lower elevations
Black-headed Grosbeak (*Pheucticus melanocephalus*): fairly common low to high elevations chap. mc, jp, etc.
Purple Finch (*Carpodacus purpureus*): fairly common lower mcf, co, bdf
Cassin's Finch (*Carpodacus cassinii*): common at upper elev mcf and jp, males can imitate other species (e.g. scrub jay, wren-tit)
Red Crossbill (*Loxia curvirostra*): flocks in cp near Upper Bear Camp
Lesser Goldfinch (*Carduelis psaltria*): common throughout.
Lawrence's Goldfinch (*Carduelis lawrencei*): uncommon, overhead in lower Sisquoc

MAMMALS:
Black Bear (*Ursus americanus*): common sign seen throughout, individuals seen at Bear Meadow along upper Big Pine Canyon
Mule deer (*Odocoileus hemionus*): several seen in four days throughout
Mountain Lion (*Felis concolor*): tracks seen along trail near West Big Pine
Bobcat (*Lynx rufus*): tracks seen along road near old Alamar Station site.
Coyote (*Canis latrans*): sign seen several places
Gray Fox (*Urocyon cinereoargenteus*): sign seen several places up to crest
Brush Rabbit (*Sylvilagus bachmani*): seen along lower Sisquoc
Blacktail Jackrabbit (*Lepus californicus*)*
Merriam Chipmunk (*Tamias merriami*): common in mcf. jp, mc, chap, cp, etc.
Western Gray Squirrel (*Sciurus griseus*): common in mcf, co, cp
California Ground Squirrel (*Spermophilus beecheyi*): uncommon seen only at "Bear Meadow" ca. 5800 ft
Broad-handed Mole (*Scapanus latimanus*): tunnels seen at Upper Bear Camp, etc.
Valley Pocket Gopher (*Thomomys bottae*): excavations and tunnels at upper elevations as well as along lower Sisquoc River canyon
Pacific Kangaroo Rat (*Dipodomys agilis*):*
California Mouse (*Peromyscus californicus*):* trapped
Brush Mouse (*Peromyscus boylei*): * trapped
Deer Mouse (*Peromyscus maniculatus*): *trapped
Pinyon Mouse (*Peromyscus truei*): *
Dusky-footed Woodrat (*Neotoma fuscipes*): houses seen in cp and in mc up to near summit of Big Pine Mountain.

California Myotis (*Myotis californicus*): * netted at Bluff Camp (about 1.5 miles S of RNA)
Western Pipistrelle (*Pipistrellus hesperius*): *netted at Bluff Camp
Hoary Bat (*Lasiurus cinereus*); *
Pallid Bat (*Antrozous pallidus*): *netted at Bluff Camp

PHOTO CAPTIONS FOR
BIG PINE MOUNTAIN ECOLOGICAL SURVEY

Photo 1: *Thermopsis macrophylla* dominating an understory opening in mixed coniferous forest on the summit crest of Big Pine Mountain.

Photo 2: Spectacular escarpments form the southern boundary of the area near West Big Pine. A recent California condor nesting site is located in this area.

Photo 3: The 400 ft tall cliffs over the northern side of lower Big Pine Canyon.

Photo 4: A 50 ft high water fall on the upper Sisquoc River near Lower Bear Camp.

Photo 5: The sugar pine – white fir phase of the mixed coniferous forest on the north slope of Big Pine Mountain

Photo 6: The open understory typicall of the upper slope mixed coniferous forest on the upper north slope of Big Pine Mountain

Photo 7: View from the south slope of Big Pine Mountain showing sharp fire-related altern along the crest between mixed coniferous forest and northern mixed chaparral.

Photo 8: The western edge of a mixed coniferous forest stand along the Mission Pines trail is adaphically controlled by the ourcrop fo argillaceous shale in the foreground. Note stunted Jeffrey pine and incense-cedar, main mixed coniferous forest stand on Big Pine Mountain in background.

Photo 9: Large 5.5 ft dbh incese-cedar surrounded by poles of white fir in the alluvial flat stand of mixed coniferous forest at Upper Bear Camp.

Photo 10: Grassy glad at Upper Bear Camp surrounded by ca. 100 year old forest dominated by white fir. Grassland in foreground is dominated by *Muhlenbergia rigens*, note montane riparian scrub along intermittent stream.

Photo 11: Mixed ahaparral dominated by chamise and *Arctotaphylos glauca* on southwest-facing slope of lower Big Pine Canyon. Coulter pine in foreground.

Photo 12: sparse understory typical of mid-slope closed canyon live oak forest. Stems are ca 12 inches dbh and 30 ft tall.

Photo 13: Interior of relatively dense Coulter pine-chaparral phase on north-east slopes.

Photo 14: A belt of Coulter pine-chaparral vegetation frequently separates the notthern mixed chaparral from the canyon live oak forest in the Big Pine Canyon drainage. Bigcone Douglas-fir in ravine in foreground.

Photo 15: Typical stand of bigcone Douglas-fir/canyon live oak on north slope of Sisquoc River Canyon.

Photo 16: Bigcone Douglas-fir/canyon live oak forest in Big Pine Canyon; note incense-cedar and tall stems of canyon live oak.

Photo 17: Open and stunted Jeffrey pine forest on shale and shallow sandstone soil. Understory dominated by scrubbly canyon live oak, Parry manzanita, and *Garrya flavescens* ssp. *pallida*.

Photo 18: Ridgetop stand of Jeffrey pine on crest of Big Pine Mountain. The deep sandstone soil supports herbaceous vegetation dominated by *Lupinus elatus*.

Photo 19: Closed canopy of white alder slong Sisquoc River.

Photo 20: Dense clump of *Lilium pardalinum* in seepy riparian area along Sisquoc River.

Photo 21: Well-structured stand of white alder riparian at Lower Bear Camp with bigleaf maple and understory dominated by *Artemisia douglasiana*.

Photo 22: wiew north across a shale barrens east of West Big Pine. Parry manzanita-dominated montane chaparral and stunted mixed coniferous forest in background.

Photo 23: *Lomatium dasycarpym* (left) and *Psoralea californica* (right), two characteristic species of the shale barrens.

Photo 24: A concave slope in shale barrens with high cover of *Eriophyllum confertiflorum*, *Madia elegans*, and *Chrysothamnus nausiosus*.

Photo 25: A permanent pool in sandstone in the mid portion of Big Pine Canyon.